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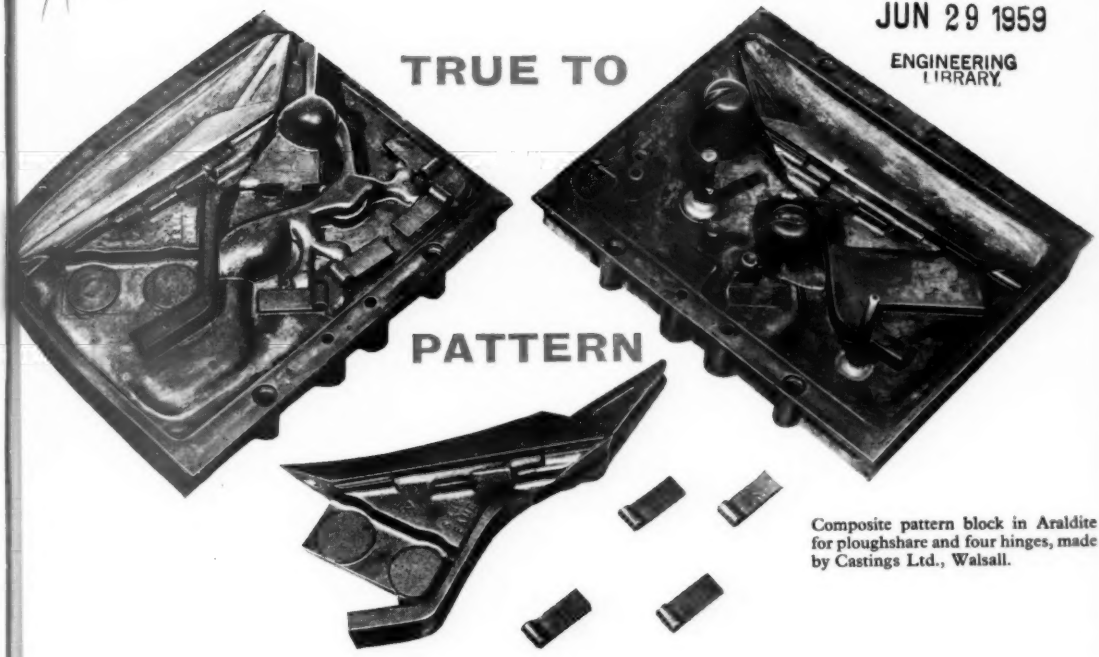

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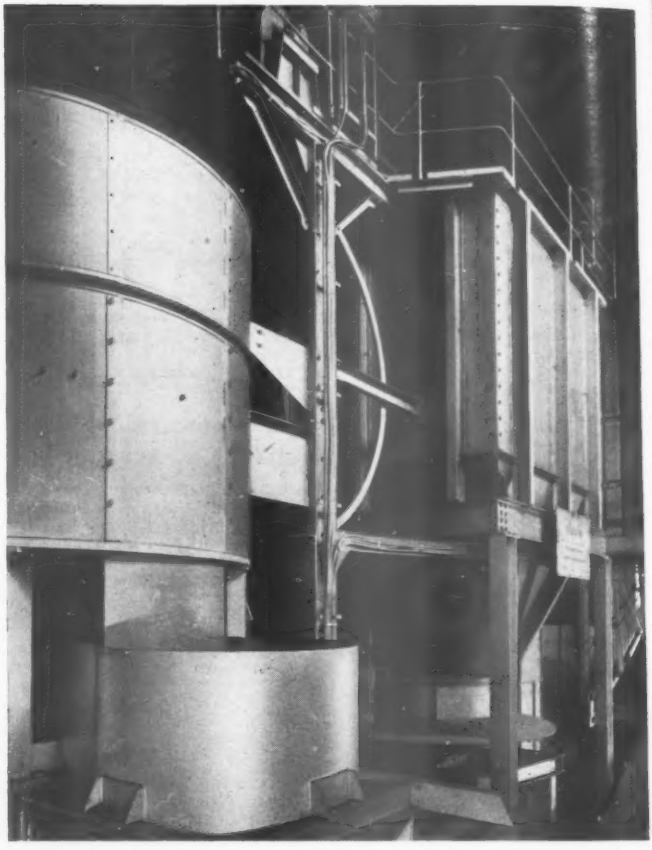

• *Photograph shows:*

Large storage hopper with rotary table, feeding new sand to a bucket loader, which in turn, charges a 3F size Mix-Muller—batch capacity 4,000 lbs.

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FOUNDRY
TRADE JOURNAL

Vol. 106 JUNE 4, 1959 No. 2225

# In the Interests of Dimensional Accuracy

In days gone by, the moulder, acting as he thought in his employer's interest, was heavy-handed when drawing patterns from the mould, for then the casting came out larger than the pattern and it was usual to sell castings by weight. Later, with the advent of moulding machines, the mechanical withdrawal of patterns effected a great improvement in the dimensional accuracy of the casting made, but there were still variations due to different hardness of ramming, varying sand quality and other factors, all of which have been—and are still—the subject of intensive research and further improvement. During the war, there was a demand for turbine blades to be cast from an unmachinable material; this was satisfied by resort to a modified lost-wax process and, later, methods of this nature were greatly elaborated.

Well before the war, in parallel search for repetitive accuracy of components, there was a demand for castings in aluminium and zinc alloys which would not stand the cost of much machining or which if made in sand involved much time spent in coring up. These requirements were satisfied by resort to die-casting and now in the case of aluminium alloys, the output in the UK far exceeds that of the sand foundries (last month, for example, the output of pressure-die-castings alone exceeded that made in the sand foundry). When, shortly after the war, shell moulding was introduced, involving the use of accurate metal patterns, the buyer received castings which greatly reduced his machining costs. The impact on the foundry industry generally was such that all repetition foundries devoted much greater attention to pattern equipment than ever before. By and large, the $CO_2$ Process has also made a worthwhile contribution towards greater accuracy in foundry products.

Whilst there are no reliable statistics to reinforce the claim that castings entering into the precision class—using the word in its widest sense—are greatly expanding at the expense of the conventional type, our general familiarity with the industry convinces us that this is so. Statistics do show that there has been some reduction in the weight of castings produced annually, but there is no reason to suppose that the value of the output of the foundry industry is declining. We attach so much importance to process developments that, periodically, we intend to include in the JOURNAL a section covering the newer methods, having for their end the production of castings, the dimensions of which are such that machining is either eliminated or greatly reduced. A casting is the shortest method of translating a design into a finished article and when this is really well carried out, the method still shows the greatest potentialities.

## Carron Bicentenary

The celebrations commemorating the bicentenary of the foundation of the Carron Company, Falkirk, took the form of banquets held on three consecutive evenings in a newly-erected assembly shop. Altogether nearly 3,000 people were entertained; the guests included the workpeople, pensioners of the company, customers, neighbouring employers and the civic authorities. About a dozen of the girls on the staff, each provided with a nice blue frock, acted as hostesses—a quite necessary adjunct for such large gatherings. The functions were presided over by Mr. E. J. Leaver, the manager of the Carron Company, which is not a limited liability company, but one established by a Royal Charter. Thus instead of a board of directors, there is a "General Court." In a short address, Mr. Leaver gave a little of the history of the company, stressing the advantages and drawbacks of an ancient foundation. Once, he said, it was discovered that in a gang of seven or so, one man did nothing—investigation showed that his job originally had been to hold the horse. During its 200 years of existence, the company had experienced many ups and downs but the happy outcome was that it was now the oldest iron works in the country that had not been absorbed or amalgamated with other concerns.

The toast of the Carron Company was given by the Hon. A. W. Roebuck, Q.C., a Canadian senator and the great-great grandson of Dr. Roebuck, the founder of the company. He related how his ancestor had had a financial reverse, through investment in coal mining, and because of that the family had migrated to Canada. The toast was replied to by Mr. C. H. Burder, M.B.E., the Proeses of the General Court of the Carron Company. The Oxford English Dictionary gives no clue as to what a Proeses is, but the writer was told that the office resembled that of the company secretary.

An excellent entertainment was provided, which included the performance of a hefty young lady who broke 6-in. nails. Finally, there was an appreciation of the efforts made by the company for the employees' welfare by an old gentleman who had over 50 years' service with the company. He recalled the change-over from horse-driven carts to motor lorries. The evening finished with the singing of Auld Lang Syne.

## *Dinner*

### WORSHIPFUL COMPANY OF FOUNDERS

The Worshipful Company of Founders held its annual ladies' dinner at the Ironmongers' Hall, London, on May 27, the Master, Mr. G. W. Ilsley, A.C.A., presiding. The toast list was the responsibility of Mr. J. Currie Thomson, M.B.E., T.D., M.A., J.P.; Mrs. G. W. Ilsley; Mr. Kenneth Adams, A.C.A. (past-Master) and Mr. H. Wilson Wiley, M.A. (the Clerk). During and after dinner, the company was entertained by Miss Sheelagh Gallwey and Mr. John Daley using two pianos.

THE HON. P. A. GAGLARDI, Minister of Highways and Public Works in British Columbia's provincial Government, visited the works of Aveling-Barford, Limited, on May 23. After operating one of the company's new dumper trucks, and inspecting other road-construction vehicles, he is reported to have announced that his Government would place an order with the firm.

## Perkins to ship Production Line to Brazil

One of Britain's leading diesel engine manufacturers, F. Perkins, Limited, Peterborough, is to uproot a whole production line and ship it to Brazil. It was announced last week that the company is entering the South American market where it will manufacture the powerful six-cylinder Perkins diesel engine for 5-6 ton trucks.

A new company, Motores Perkins, SA, has been formed in Brazil after an agreement between Perkins and Murray Simonsen, SA, a well-known Brazilian organization. The capital of approximately £2,000,000 will be shared equally between the two undertakings and part of this will be taken up in shares by the British company through the transfer of the production line from the Peterborough works worth between £500,000 and £750,000. First managing director will be Mr. Francis Holt, an engineer on secondment from Perkins, who has had many years' service in South America. Key chargehands from Peterborough are also to go out to train Brazilian personnel.

Mr. M. I. Pritchard, managing director of Perkins, said that the project had been approved by the Brazilian Government and production was scheduled to start in the second half of next year. It was expected to reach an annual production of 18,000 to 20,000 engines by 1962. The production line, which weighs about 1,000 tons, was being shipped next month and was probably the biggest single consignment of machine tools sent to Brazil from Britain since the war. It would be installed in a factory at Saõ Bernardo, on the outskirts of Saõ Paulo.

The production line is being replaced at Peterborough by a new combined line for six-cylinder engines in current production and certain new engines at present under development. Mr. Pritchard said there was no question of anyone being redundant as the result of the transfer of the production line.

## Meehanite Conference

The annual conference of the International Meehanite Research Institute, held this year in Sirmione on Lake Garda, Italy, from May 18-22, was attended by some 130 delegates from Meehanite foundries from 11 countries. The papers discussed covered subjects ranging from basic melted metal to casting cleaning methods and the latest developments and progress in the Meehanite field were also discussed. These developments included the production of 80-ton irons, irons with elongation in excess of 20 per cent. in the "as cast" condition and the short cycle annealing treatment to produce irons of exceptionally high-impact value. Papers on sales and production methods were also presented.

The conference included visits to Meehanite licensees, Ceccato, Alte Ceccato, Vicenza, a foundry specializing in the production of small motor-cycle cylinders, air-compressor cylinders and other similar work, and Nebiolo, Torino, one of the most modern foundries in Europe, where a television camera is installed on the cupola charging stage with monitors in the Meehanite control room and by the charge make-up station.

THOMAS WRAGG & SONS (SHEFFIELD), LIMITED, Storrs Fire Clay Works, Loxley, near Sheffield, one of the largest suppliers of casting pit refractories in the country, were visited by the Master Cutler, Mr. J. Hugh Neill, on May 25.

# Foundries in East Africa

*By W. J. Roscrow**

**This article deals with the limited foundry industry existing in East Africa to-day. The author has spent the last three years there, during which time he had some interesting experiences, amongst which was the starting up of the small foundry known as East African Rolling Mills, Limited. East Africa is a land of vivid contrasts, colour and interest, with a climate ranging from the cool English weather found in the Highlands of Kenya, to the hot tropical zones of the plains and coastal areas.**

Apart from the East African Railways and Harbours, the largest consumers of castings in East Africa are the gold and silver mines of Kenya and Tanganyika. These mines use castings such as ball mill liners, and mill grinding balls, in large numbers. Such castings are specialized products, and were not until recently produced in East Africa. The next largest market for castings exists in the supply of cast-iron roadwork components, such as manhole covers and frames, inspection covers and frames, and gulley gratings, etc., for the many sewerage schemes which are in progress in this developing territory. A certain amount of jobbing castings are also in demand for the limited amount of industry centred mainly around Nairobi, Kisumu, and Mombasa, and for the agricultural, sugar, cotton, and sisal industries.

## RAW MATERIALS

### Sand

There is no heavy industry in East Africa, and the majority of foundry raw materials have to be imported, either from the Union of South Africa, or from Europe. Sands suitable for moulding undoubtedly exist in East Africa, but have not been exploited due to the smallness of the foundry industry. The foundry with which the author was associated obtains its sand supplies from a company, situated at Voi on the borders of Kenya and Tanganyika, which mines kyanite. This sand consists of the tailings from the processing plant extracting the kyanite, and being highly refractory and of suitable grain distribution, it forms an ideal base sand for foundry purposes. It is used throughout the foundry for both conventional sand moulding, and the comparatively recently-developed shell-moulding process. Kyanite is the raw material from which high-grade Mullite refractory bricks are produced, and ample reserves of this material are available. Observations made have led to the belief that the refractory deposits in existence could support a foundry industry of quite large proportions.

### Refractory Bricks

A small refractory-brick-making concern in Nairobi produces bricks in small quantities for various purposes (ranging from foundry cupolas to mine kilns), and these bricks are also being tested for use in the locomotives of East African Railways and Harbours. They are manufactured from a refractory-clay deposit located some 80 miles from Nairobi. The author's experience is that they are capable of reasonable results, but suffer from inconsistency in quality. However, the Company has recently installed a new beehive kiln, which, with its better control over the firing of the bricks, should enable them to supply bricks of greatly improved quality.

### New Lining Developed

The ground around Nairobi, and that stretching to the Kenya highlands, consists for the most part of either a light red soil, or heavy black plastic clay known as black cotton. Black-cotton soil is looked upon as something of a curse in East Africa, being either baked hard as iron in the sun, or a glutinous mass during the wet season. The author discovered that both these materials are essentially refractory clays, and very suitable for foundry purposes, and, in conjunction with the East African Industrial Research Organization, a blend of black-cotton soil, quartz, and kyanite sand, has been developed as a rammed lining for the cupola, rotary furnace and Tropenas converter. This lining has been found to be superior to the previously imported monolithic ramming material, and considerable savings in refractory costs have thus resulted.

*Amusing Experience*

The red soil referred to is particularly suitable for growing coffee, and its introduction as a clay bond for moulding sand was the cause of one of the author's many amusing experiences in East Africa. Trouble was being experienced in the author's foundry due to loss of plasticity in the moulding sand, and the search was on to find a suitable local material to replace the expensive imported clay being used at this time. During this period one of the African moulders insisted that the author should use red soil from his shamba (garden) as a clay bond in the sand. This amounted, in the author's mind, to using earth as a moulding material! However, the man was so insistent that the author finally obtained a lorry load of "red earth," and gave it both a laboratory test, and a foundry trial on some castings. Much to his surprise the material turned out to be essentially a

* The author is on the staff of the Monometer Manufacturing Company Limited.

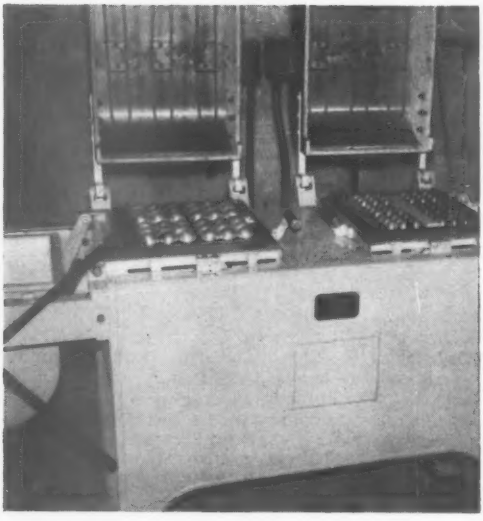
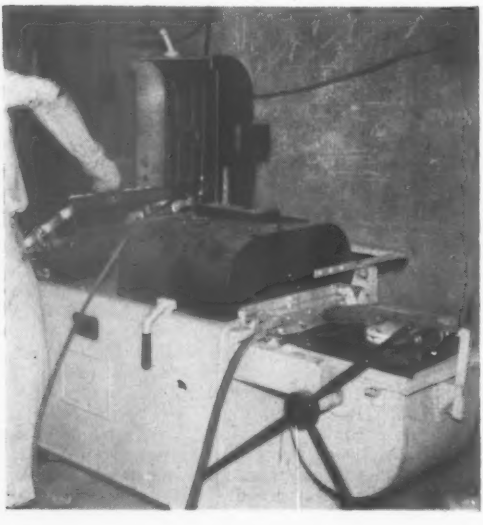


FIG. 1.—*Double-station shell-moulding machine at the works of East African Rolling Mills, Limited, Nairobi. The machine is of the simple dump-box type, with electric radiant pattern-heaters hinged from the rear.*

refractory clay, and the sand troubles experienced in the foundry disappeared. The iron-oxide content of the clay gave the sand ability to retain its plasticity over a much extended period of use, thus reducing materially the additions needed during each reclamation, and giving the sand a much better working property than before. Graphite for the author's foundry is obtained locally from a very good deposit near Nairobi. The quality is excellent, and the output of the mine is largely exported. However the foregoing are the only locally produced raw materials available to the foundries of East Africa.

FIG. 2.—*Operating the Polygram Simplex shell-moulder—one shell is being cured, while the second is invested.*



### Pig-iron, Coke and Scrap

Iron ore and coal deposits do exist in large quantities in East Africa, but due to the terrain of the country involved, and the lack of transport at these locations, it will be a long time before any exploitation can take place. Pig-iron and coke are available from the Union of South Africa, and pig-iron also from Rhodesia. Foundry-grade pig-iron costs approximately £28 per ton at Nairobi (delivered from South Africa), whilst coke purchased in minimum 100-ton consignments costs £15 per ton. The pig-iron is of reasonable quality, but the South African coke is very poor when judged by normal United Kingdom foundry standards. It has a low fixed-carbon percentage, and high ash content. However, the author's foundry obtains all its coke supplies from the Union, due to the very high cost of English coke imported into East Africa.

*Iron and Steel Scrap*

Iron and steel scrap over the three Territories of East Africa is collected by a subsidiary of George Cohens, Limited, and is mostly exported to Japan and the Continent. Supplies are sufficient at the moment for a small foundry industry only. Delivery prices at East African foundries average £10 to £12 per ton.

## FOUNDRIES

### EARH Foundry

The largest foundry in East Africa is that operated by the workshops of East African Railways and Harbours. It is located in the industrial area of Nairobi, and operates solely for the convenience of the Railways and Harbours. Castings are made in both iron and non-ferrous metals. The foundry is not mechanized, and is essentially a jobbing shop, but repetition castings (such as brake blocks) are produced with jolt-squeeze machines and a shell-moulding section equipped with Polygram machines. Iron for the foundry is melted in two 34-in. nominal diameter cupolas of conventional design, together with a 3-ton Monometer oil-fired rotary furnace. Non-ferrous metal production is catered for by Monometer and Morgan-Crucible oil-fired tilting furnaces, whilst the occasional large non-ferrous casting is supplied with metal from the Monometer rotary. This foundry enjoys special privileges (for instance, it is free of import duties and freight charges on essential materials), and operates essentially as a convenience rather than a commercial foundry.

### Small Establishments

*Gailey and Roberts*

Gailey and Roberts, Limited, is a foundry, situated in the industrial area of Nairobi, which manufactures all types of roadwork castings in cast-iron and brass, these castings being marketed in East Africa by Gailey and Roberts themselves, who are a subsidiary of Unilevers. This foundry employs no mechanization, and iron is melted in a small cupola.

*Onslows*

Onslows, Limited, operate at Kisumu in Kenya, some 300 miles from Nairobi, on the shores of Lake Victoria. This foundry manufactures mainly jobbing castings for various purposes, metal being melted in a 24-in. cupola and a 30-cwt. capacity oil-fired Stein and Atkinson rotary furnace.

Mombasa, the principal port of Kenya, has two foundries—African Marine and General Engineering Company, Limited—Stirling Astaldi, Limited. The first-mentioned manufacturers emergency-repair castings for shipping using the port of Mombassa. Stirling Astaldi produce iron castings for civil engineering contracts, and also undertake other work. They also have a small jobbing foundry with a small cupola.

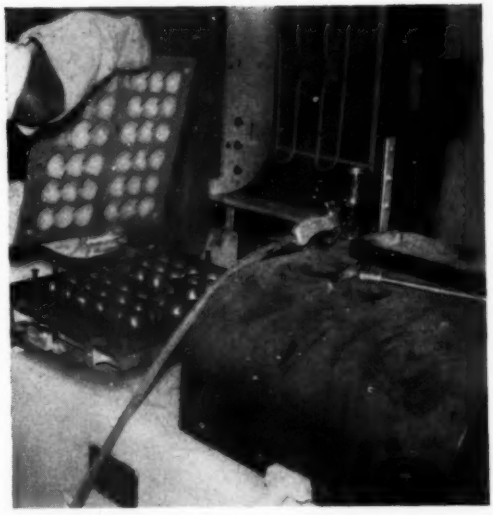


FIG. 3.—*Stripping a cured " biscuit " from one of the patternplates.*

### East African Rolling Mills

East African Rolling Mills, Limited (a private company), erected a foundry in Nairobi during 1956, initially with the object of producing small tonnages of mild-steel reinforcing bars to B.S.S. 785 for the local market existing in the three territories. They installed a very old rolling mill which had previously operated at Korogwe in Tanganyika by re-rolling scrap. This mill consisted of a four-stand, 6-in. finishing-mill and a 12-in. cogging stand. The new foundry was equipped to produce 4-in. billet ingots in mild steel to B.S.S. 785 for this rolling mill. Bearing in mind the high cost of electricity in Nairobi, and the cost of imported pig-iron, the following interesting system was developed for metal processing.

*Metal-melting Set-up*

A 30-in. hot-blast cupola was installed as the major melting unit, operating on 100-per cent. steel-scrap charges, and using the low-grade South African coke as a fuel. The cupola fed hot liquid-iron to a Monometer oil-fired rotary furnace, which acted as a receiver for desulphurization and subsequent raising of the temperature of the iron to 1,500 deg. C. After superheating, the metal was fed to a 25-cwt. capacity Tropenas converter for blowing to mild steel. A very interesting feature of the rotary furnace installation, in these days of complicated hot-blast systems, was the incorporation of two heat-exchangers in the exhaust system of the furnace. One of these heat-exchangers supplied hot blast to the cupola, while the other returned hot combustion-air to the rotary furnace in the normal manner. The equipment was arranged so that molten iron could be taken from

FIG. 4.—*Teeming shell-moulded grinding balls at the East African Rolling Mills, Limited, foundry. For pouring, the moulds are stacked vertically, backed with sand.*

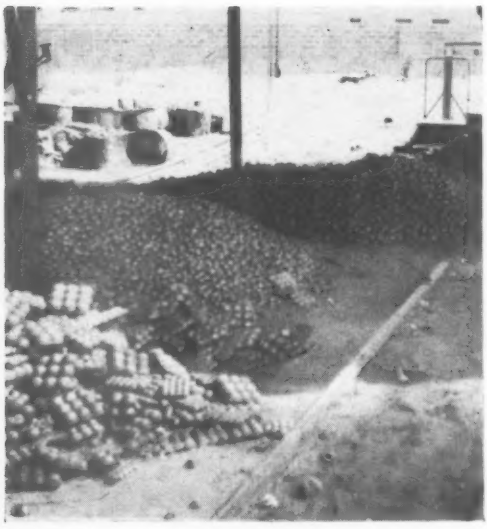


FIG. 5.—*Stock of small-size mill grinding balls.*

the cupola for the production of castings, whilst the rotary furnace was employed as a cold-charge melting unit. The hot-blast cupola was operated at a temperature of 400 deg. C., and molten iron, after desulphurization, was fed to the Tropenas converter at a temperature of 1,500 deg. C. By using metal at this temperature the side-blown converter could be operated satisfactorily with iron of a low silicon-content, with consequent saving on ferrous alloys.

*Rolling found to be Uneconomical*

Unfortunately the production of reinforcing bars was not an economic success due to two factors: (1) The very old mill, after installation, proved incapable of handling the melting potential of the converter equipment, and (2) the subsequent selling price of reinforcing bars imported into Kenya from the Continent and Japan made it impossible to compete with them. It was therefore decided that the plant should be operated only as a foundry.

*Concentration on Production of Mill Grinding Balls*

The foundry now concentrates on the production of mill grinding balls, for which a ready market exists in the mines and cement works of East Africa. Roadwork castings and pipe specials to B.S.S. 497/1952 and B.S.S. 78/1938 are also produced, this being made possible by the foundry having its own laboratory. (All the iron castings and pipe specials for the Kitale sewerage scheme were supplied by the author's firm.) Grinding balls in martensitic chrome alloy are manufactured in sizes ranging from 1 to 4 in., the larger sizes (2 to 4 in.) being used by the gold and copper mines of Kenya and Tanganyika, whilst the 1- to 1½-in. sizes are purchased for the cement works at Tororo, Uganda.

The 4-in. balls are produced by green-sand moulding on a squeeze machine, the moulds being centrally gated and then stacked for pouring. The smaller sizes are shell moulded and cast in a unique manner, which enables large quantities of shell-moulded balls to be poured at considerable speed. The method is described in what follows, and illustrated in Figs. 1 to 4. A stock of the smaller sizes of grinding balls is shown in Fig. 5.

*Pouring Shell-moulded Balls*

Shell moulds, after assembly, are stacked side by side in metal boxes mounted on trolleys. These trolleys are arranged on a rail track to pass a fixed pouring-point, where a ladle is held suspended from a monorail. After being stacked side by side in the boxes, the moulds are clamped in the box by means of a plate actuated by a turnscrew on the outside of the box. The boxes are then filled with silica sand, and a communal runner made between the individual shells by means of resin-sand cured around the runner section of the moulds. This curing is speedily done by means of portable electric canopies, made from sheet aluminium, and containing a bar-type electric element. Each box passing the pouring point holds 15 shell moulds, giving a weight of 5 cwt. of 2-in. grinding balls. This method allows a 1-ton capacity ladle to be teemed with the minimum of delay and trouble. It has been found that a Polygram Simplex shell-mould maker, with two African operators, maintains a production of 20 complete shell moulds per hr. This system of producing grinding balls has proved very effective.

## LABOUR

The African worker's temperament is very suitable for repetition work, but he must be constantly supervised, as he very rarely allows any sense of responsibility to govern his work. Maintenance of machinery is a constant problem. The author's experience is that, however well-made a machine, if one employs an African operator trouble is soon experienced, and constant maintenance is necessary. Africans make very good moulders, being temperamentally suited to this type of work, but to obtain an economic production from a foundry they must be employed under some incentive system. A collective bonus based on a certain daily output of castings was found to be a simple and workable scheme. The wages paid to African moulders are certainly not high when compared with English standards, but in considering this matter a large number of factors must be considered, and it is very difficult to make comparisons.

**Acknowledgments**

Thanks are due to the directors of East African Rolling Mills, Limited, for their permission to publish the information given in this article.

# Dust Control on Fettling Benches

*By C. M. Stoch and R. H. Brown**

**Account of work done by the British Steel Castings Research Association on the design of an effective exhaust system for a fettling bench, and on the reduction of noise-level. A detailed and illustrated description of an experimental fettling bench is given, and the article concludes with a summary of results obtained during the experiments and ensuing works trials.**

The dressing of small and light castings is often done on fettling benches, and on the basis of observations obtained from steel foundries it is considered that the best practical way of controlling the fine dust generated during dressing is by a local exhaust system fitted to the bench. The main advantages of this method of controlling dust are that the exhaust does not interfere with the normal work of the operator; and he is not required to adjust the exhaust in any way. The performance of the exhaust system is therefore stable and reliable.

Exhausted fettling-benches have been in use for many years, and benches of various designs are available on the market. No single type of bench can be suitable for every fettling shop and some features in the design must be made to suit the requirements of a particular shop. The British Steel Castings Research Association has carried out development work on two aspects connected with fettling benches, namely: (*a*) the design of an effective exhaust system for the control of dust, and (*b*) the reduction of noise-level, associated in particular with the dressing of castings with a pneumatic chisel.

## DUST EXHAUST

### Design of an Experimental Bench

After some preliminary tests a bench top was made as follows: in a hard wood plank 3 by 2 ft. and 2 in. thick, 15 holes were drilled to accommodate 9-in. long pieces of pipe of 1½-in. bore. A 6-in. deep shuttering was made, and concrete was poured on top of the plank and around the pipes. When hardened, the slab was placed on a steel support with the wooden face upwards. Ducting around the bench top, and a hood at the back, were built of wood and hardboard in order to facilitate any alterations found to be necessary during the experimental work. The outline of the design of the bench is shown in Fig. 1. To assess the effect of directing the exhaust air through different inlets provided in the bench the main duct at the back of the bench was made in three sections, each fitted with a damper so that the exhaust rate could be independently adjusted through:

(*a*) Round openings in the bench top and the front slot.

(*b* Slots on the remaining three sides of the bench top.

(*c*) Slots in the back screen of the hood.

The main duct was connected to an exhaust fan with a maximum capacity of 3,000 cub. ft. per min.

The pre-cast holes in the bench top have been found useful for locating pegs or clamps, which might be used to prevent the casting from sliding about on the working surface during dressing. A convenient rest was made, consisting of two pieces of 1½-in. angle iron welded together at 60 deg. These pieces form a Vee to which two pegs are welded, so that the rest can be positioned in the holes.

### Observations of Air and Dust Flow

Preliminary tests using smoke trails and high-intensity illumination showed good dust-control with an exhaust of 1,500 cub. ft. per min. It was also observed that, when grinding, the fine dust was brought under control by the exhaust through the openings in the top of the bench, and that the effect of the exhaust through the slots in the vertical back wall was negligible. It was observed further that it was of utmost importance to provide an exhaust through a slot along the front edge of the bench. If this flow of air was eliminated, by covering the slot, dust clouds travelled up the operators chest towards his breathing zone.

Best results were obtained by applying the exhaust through the holes in the bench top and through the slots at both sides and at the front of the bench top. Velocities of air flowing into the openings (using a Velometer), and the distribution of the exhaust volume for two settings of the main damper, for a total exhaust rate of 1,500, and 2,000, cub. ft. per min., are given in Table 1.

TABLE 1.—*Results of the Measurements of the Exhaust Air Flowing through the Various Openings in the Bench Top.*

| Exhaust through: | Setting 1. | | Setting 2. | |
|---|---|---|---|---|
| | Average velocity, ft. per min. | Exhaust rate, cub. ft. per min. | Average velocity, ft. per min. | Exhaust rate, cub. ft. per min. |
| Slot along the front of bench .. .. | 725 | 540 | 1,000 | 750 |
| Slots along both sides of bench .. .. | 650 | 650 | 900 | 900 |
| Holes through the bench top .. .. | 1,700 | 310 | 1,900 | 350 |
| Total .. .. | | 1.500 | | 2,000 |

* Mr. Stoch and Mr. Brown are respectively, head of the engineering section, and senior investigator, with the British Steel Castings Research Association.

*Dust Control on Fettling Benches*

### Effectiveness of the Exhaust

Following the preliminary observations of the dust flow under varying exhaust conditions, a test was carried out to obtain some measure of the efficiency of the dust-control when chipping and grinding steel castings. Sampling of the dust concentration in the operator's breathing zone was done with a thermal precipitator fastened on his chest, and samples were taken also of the general atmosphere in the shop. The conditions of the tests, and the results of sampling, are summarized in Table 2.

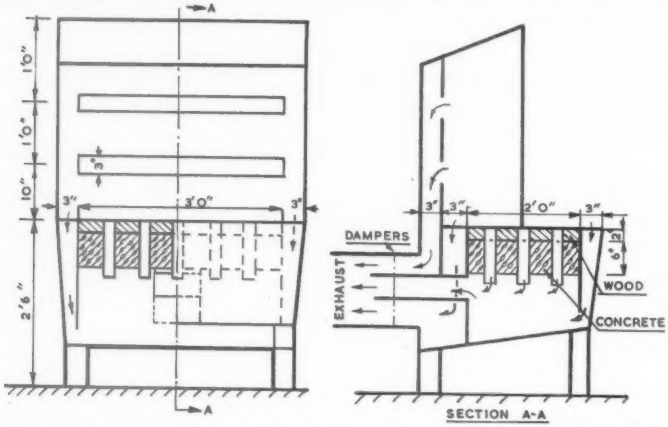



FIG. 1.—*Side, and front elevation, section views of the BSCRA experimental fettling bench.*

TABLE 2.—*Conditions, and Results, of Tests on an Exhausted Fettling Bench.*

| Sample No. | Conditions of test. | | | Thermal precipitator samples (particles of dust per c.c.). |
|---|---|---|---|---|
| | Operation. | Period | Exhaust (cub. ft. per min.). | |
| 1 | Grinding | 15 min. | 1,500 | 945 |
| 2 | Grinding | 11 min. | NO exhaust | 3,250 |
| 3 | Grinding | 15 min. | 2,000 | 305 |
| 4 | Grinding | 12 min. | 2,000 | 180 |
| 5 | Chipping | 15 min. | 2,000 | 260 |
| 6 | General atmosphere | | | 350 |
| 7 | General atmosphere | | | 305 |
| 8 | General atmosphere | | | 225 |

It can be seen from Table 2 that, when grinding with no exhaust, the dust-concentration in the operator's breathing zone was 3,250 particles per c.c., whilst with an exhaust of 1,500 cub. ft. per min. in operation the concentration was reduced to 945 particles per c.c. With an exhaust of 2,000 cub. ft. per min. the average dust-concentration of the two tests was 243 particles per c.c., whilst the average dust-concentration in the general atmosphere was 290 particles per c.c. A dust sample taken during chipping of castings (Sample No. 5) gave a dust-concentration in the operator's breathing zone of 260 particles per c.c., which is very close to the figure for the general atmosphere.

The photograph shown in Fig. 2, which was taken with the aid of an illumination technique to disclose the clouds of fine dust, illustrates the effectiveness of the exhaust in preventing the cloud of fine dust from rising into the operator's breathing zone. The sampling head of the thermal precipitator can be seen on the operator's chest.

### Works Trials

Following the tests under laboratory conditions, the bench was installed in the fettling shop of a steel foundry, and used under normal working conditions for three months. Several experienced fettlers worked in turn on the bench to obtain as wide comments as possible. Their remarks were summarized as follows: (*a*) even when dressing very dirty castings the performance of the exhaust was satisfactory, (*b*) the effectiveness of the dust removal was particularly noticeable, since no sweeping-down of the bench was required. After this period of work the top layer of the bench, which was made of hard wood, showed very little wear.

## NOISE PROBLEM

The high noise-levels produced during fettling arise from three sources: the casting, the support for the casting, and the fettling tool. Experiments have shown that a wooden bench used as a casting support will set up high noise-levels, whilst a large solid mass will be much quieter. For example, chipping a casting on a wooden bench produced a noise-level of 107 decibels, whilst the same operation on a solid concrete floor produced only 100 decibels. It is important to bear in mind that the decibel is based on a logarithmic scale. A reduction of decibel level from 107 to 100 corresponds to a reduction in noise-pressure level at the ear of 55 per cent. The effect is mainly one of suppressing unnecessary vibrations which may be transmitted to the main fettling-shop structure, together with a reduction in excessive casting vibration due to "springiness" in the casting support. On the present bench this reduction has been achieved by using massive concrete slabs to form the main bench structure.

Extraneous reflected noise, mainly from the fettling-tool and casting, can be controlled by the use of sound-absorbent panels fixed to the bench hood, the peak noise-absorption characteristics of the panels corresponding to the peak noise-frequencies set up during fettling. By these means substantial reductions in noise levels can be obtained.

## CONCLUSIONS

Tests of the effectiveness of the local exhaust system applied to a fettling bench, and investigations of the noise-level during dressing of castings, have shown that:

(1) A considerable reduction in the noise-level is obtained by making the bench top as a solid concrete slab, covered by a layer of material not producing dust (*e.g.*, wood).

(2) An effective dust-control is obtained with the exhaust operating through the slots made in the bench top, and the provision of an exhausted slot along the front edge of the bench is essential.

(3) To direct the ventilating air around the operator's body it is essential to make screens at the back, the sides and extending over the bench, but no improvement in dust-control is obtained by providing exhausted slots in the back of the screen.

(4) With an exhaust of 2,000 cub. ft. per min. (bench top 3 by 2 ft.) in operation, the dust-concentration (sampled by thermal precipitators) in the operator's breathing zone was of the same order as the dust-concentration in the general atmosphere.

(5) Under production conditions in a steel-foundry fettling-shop the bench met with favourable comments from the operator working on it.

(6) This principle of design can be applied to benches over a wide range of shape and size, and has already been applied to benches with both rectangular and circular working-surfaces.

The design of this bench is the subject of British Patent Application No. 5725/59. Arrangements have been made with two companies for the manufacture of benches incorporating the features of this design. The British Steel Castings Research Association will welcome inquiries from foundries interested in its application.

FIG. 2.—*Illustrating the effectiveness of the fettling bench exhaust in preventing the fine dust from rising into the operators' breathing zone.*

**Acknowledgment**

The Association's thanks are due to Osborn Foundry & Engineering Company, Limited, for the assistance given in testing the bench.

## The Baildon Steelworks

It was in 1793 that John Baildon, blue-eyed, fair youth of 21, tall and gaunt, with a pale, oval face, a native of a little Yorkshire town, arrived in Silesia. Born on December 11, 1772, he was the descendant of an old, respected family, characterized—to quote one of his biographers—by "most determined love of freedom and independence of character."

Young Baildon received sound education and, when still a youth, was considered to be a man of no mean abilities. He came to Silesia in order to supervise, in the capacity of technical adviser: "the working of foundry bellows by means of a fire engine and the putting up of reverberatory furnaces." He was induced to come to Silesia by a famous English engineer, John Smeaton, known throughout Europe, who had been responsible for the building of the Eddystone lighthouse.

Baildon had concluded the preparation of his drawings of furnaces and machinery by 1793, and with these as his most cherished possessions he set foot on Silesian soil. The Gliwice Ironworks was the first one to be built under Baildon's technical supervision. It took three years to build, and the day it commenced operation—November 10, 1796—marked a new era in the history of Silesia and even of Europe. For, with the exception of England, it was the first coke-fired blast furnace to be erected in all Europe. In this connection it might be mentioned that the first coke furnace to be built in the Ruhr Basin was that belonging to the Frederic Wilhelm Works near Mühlheim, erected in 1847. Thus Silesia was fully 50 years ahead of the Ruhr.

Continuing his work in Silesia, John Baildon concluded in 1798 the building of a coke blast furnace at Królewska Huta (known to-day as Chorzów), built an industrial plant for the Cistercian monks at Rudy and the Helena Ironworks at Bytków. His interest and activities were, however, not restricted to the building of coke furnaces. W. Paley, the biographer of the Baildon family, ascribes to him the building of the first iron bridge on the Continent, near "Strzygawska Wola" in Silesia.

John Baildon married Helen Galli, the daughter of a wealthy Italian who had settled in Gliwice, and in the course of years he amassed a substantial fortune. His dream of possessing works of his own came true when he obtained permission to build one on the banks of the River Rawa, on the spot where the boundaries of the three villages Katowice, Dab and Zaleze, met. The new works, which he called the Baildon Works, had four puddling furnaces and full auxiliary equipment.

John Baildon died in 1846 and was buried in the Gliwice cemetery.

* Abstract from an article printed in Murex *Review*, where acknowledgment is made to the Polish Chamber of Foreign Trade, Warsaw, for permission to reprint the article, which originally appeared in the *Polish Foreign Trade Journal*.

## Imports from the Dollar Area

With effect from Monday, June 8, the controls on the import of many consumer goods from the dollar area will be removed. With minor exceptions these are all items which may already be imported freely from Western Europe, but the opportunity has been taken of removing the restrictions on a few commodities which are at present controlled from both Western Europe and the dollar area. Items of interest to readers include lubricating oils; paints and pigments; domestic appliances (*e.g.*, washing machines and refrigerators); aero engines; ships, railway vehicles and light aircraft; motor and pedal cycles.

Some imports from these areas will still remain subject to control, but the so-called global quotas, which are at present open only to imports from Western Europe and certain other non-dollar countries, will be opened also to the dollar area at the beginning of the next quota year (for most commodities, January 1, 1960). It is intended that the global quotas should in general be increased for this purpose. It has also been decided to increase this year the quotas for imports from the dollar area of motor-cars.

Most of the items now covered by the Token Import Scheme will, as a result of the new measures, either be freed from restriction now or shortly be covered by the arrangements, explained above, for the import of dollar goods within the global quotas. The Scheme will, however, continue to operate for those items unaffected by the present arrangements. The effect of these measures will be a further substantial reduction in discrimination in the operation of UK import controls against Canada, the United States, and the rest of the dollar area. Over the range of goods affected dollar imports will in future receive the same treatment as imports from Western Europe, *i.e.*, in most cases freedom from control.

These measures are in accordance with the undertaking given by the President of the Board of Trade at the Commonwealth Economic Conference in Montreal last September. He then said that all being well the UK hoped this year to be able to remove import controls on as wide a range of dollar consumer goods and foodstuffs as possible.

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## BIR Congress

The Bureau International de la Récupération (BIR), held its congress and annual general assembly on May 13 to 15 at Scheveningen (Holland). Numerous delegates representing the BIR affiliated national organization from Belgium-Luxemburg, France, Great Britain, Italy, Switzerland, Western Germany and the USA assembled to partake in the work and debates of the committees, technical sections, management committee and annual general assembly.

At the meeting of the scrap iron and steel section on May 14, it was announced that the American organization ISIS (Institute of Scrap Iron and Steel) had asked to become affiliated to BIR. The announcement was warmly greeted by the assembly. The liberation of exports of scrap which took place last August in Great Britain, and which was cancelled in March this year for high-quality scrap, had helped to quieten the scrap markets in Europe.

As officers: Mr. Adloff (Germany) was re-elected for another year as section president, Mr. Verken (Belgium) and Mr. Placock (Great Britain) as vice-presidents.

## Industrial Training Grant

The Industrial Training Council met last Thursday to consider the Government's proposed grant-in-aid of £75,000, the main purpose of which is to accelerate the expansion of apprenticeship and other industrial training for young people in the exceptional circumstances created by the "bulge" in school-leavers in 1961, 1962 and 1963. This aid is to be matched by contributions from industry of at least the same amount. The Council decided to accept the Government's proposal.

Employers' organizations, directly concerned with the negotiation of wages and working conditions, are to be asked whether they wish to apply for financial aid out of the grant towards the appointment of training development officers either by the organizations or by joint industrial councils or similar bodies in their industries. The job of these officers will be to stimulate and assist in the setting up or extension of training schemes for young people by employers, either individually or through joint schemes. Application for this financial assistance may be made up to September 15.

The Council thinks that many of the organizations covering the smaller industries would not, even with grant assistance, contemplate the appointment of a full-time training officer. To assist these organizations the Council has decided to set up its own training advisory service, which will consist of a small staff of experienced training officers who would be made available to employers' organizations and joint bodies to help them work out training arrangements, and to advise their member-firms on how to apply those arrangements in individual works. The Council hopes it will be possible to establish this service in the latter half of this year.

## First-aid Boxes in Factories

Changes in the contents of first-aid boxes, or cupboards, in factories, and in the advice given on first-aid treatment are provided under a new Order published on May 26 which will come into operation on January 1, 1960. It is the First Aid Boxes in Factories Order, 1959,* made by the Minister of Labour and National Service under Section 45 of the Factories Act, 1937, and it will replace the current Order made in 1938. Issued simultaneously is a new leaflet,† which the Order prescribes shall be included in every first-aid box, giving advice on first-aid treatment of injuries arising in factories, in the light of advances made in such treatment in the last 21 years.

The Order specifies the minimum contents for first-aid boxes or cupboards in three categories of factory —those employing 10 persons or less, those employing more than 10 but not more than 50, and those employing more than 50. The same range of equipment is now to be included in each box, but the quantities vary according to the number of persons employed. The Order requires, as at present, that all materials shall be of a grade and quality not lower than the standard specified by the British Pharmaceutical Codex. Specifications for adhesive dressing for wounds, and for eye ointment, for which provision is made in the Order, are given in certificates of approval of the Chief Inspector of Factories.

* S.I. No. 906, published by H.M. Stationery Office, price 3d. net.

† "First Aid" (Form 1008) published by H.M. Stationery Office, price 2d. net.

# Perils of "Progress"

*By "Chaser"*

**Many things are demanded in a foundry—"make them stronger," "make them cheaper," "make them smoother." But while all these desirable ends are being pursued by the technical staff, they should spare a thought for the chaps in the progress department, who only ask: "make them now!"**

The hallmark of every foundry "progress" office is a battered telephone, which seems always to be in use; in fact, the telephone is probably used more for progress business than for all the rest of works organization put together. Technical matters tend to be conducted at meetings and conferences, sales and price negotiations by letter or by visits to customers, but the telephone is the progress man's own instrument. All over the world, in every country, there are people who have never met, and may never meet in person, yet who have been talking to each other on the telephone for years.

The average buyer of castings has surprisingly little idea of foundry operations. They have the general notion that castings are made by pouring molten metal into sand moulds, and very often they go no deeper than that. In a way, this is fortunate for the progress department, for the idea conjures up a picture of heat and dirt and danger which commands respect. However, there is a regrettable tendency on the part of customers to regard subsequent foundry operations, such as fettling, as mere incidentals which take no time at all. Thus if a customer urges delivery and is told: "We cannot place it in the foundry yet" or "we are having technical difficulties in the foundry," these remarks are accepted with good grace, but if he is told that his castings have been made, there is a general assumption that they are bound to be delivered at once.

### Increasing Attention to Ancillary Processing

Yet the true position is that, all the time, foundries are tending to employ fewer men on moulding and furnace work, and more on ancillary operations. The list is impressive—patternmaking, planning and methods, fettling, shotblasting (of several types), heat-treatment, inspection, metal analysis, radiography, mechanical tests, machining, packing—all very worthy occupations, but each one another hurdle before the progress man can say the only words the customer wants to hear, namely: "despatching to-day."

Times have changed since those days just after the war when founders could say: "delivery in nine months"—and be thanked for this preferential treatment! The delivery time quoted is now very often the deciding factor in getting an order, which means in practice that the staff of the progress department is augmented on occasions by such august "assistants" as the sales manager, the works manager, and sometimes even the managing director.

### Never-ending Work

Progress work never ends. One can ring up a customer to say that his castings are on the way, and back comes the reply "Oh good! you'll be pleased to hear we've just sent you a new order from which we must have the first 50 off next week for an export job. . . ."

Is a progress department really necessary? In many cases progress work seems to involve a senseless routine, but in others it does fulfil a vital function. A few days in the progress office soon gives one the instinct to sort out the really "hot" items. Here, it is worth noting that most of the industrial "giants" themselves maintain large and elaborate staffs to expedite delivery against their orders, even down to sub-sub-sub-contracts, and these so-called progress organizations seem to be on the increase, even in these cost-conscious days.

To conclude, it is an illuminating thought that, in the last resort, the need to "chase" an order can be traced back to a failure somewhere. It may be an administrative failure, such as someone forgetting to order in good time; it may be a foundry fault, such as making scrap castings and not putting the matter right quickly enough. The reasons given for wanting something in a hurry are almost as numerous as the telephone calls themselves, but all can be traced back to somebody letting somebody down somewhere. Progress men everywhere should unite and demand greater efficiency . . . , but they haven't the time, their telephones are ringing!

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THE BROCKHOUSE ORGANIZATION announces the appointment of Mr. W. H. Solf as its European representative. He will be responsible for co-ordinating and supervising the group's activities in this area and will be based at the London office of Brockhouse (Trading Facilities) Limited, 25, Hanover Square, London, W.1. After an initial period at the group's head office in West Bromwich, Mr. Solf will be starting a tour of Europe in June.

A COMMITTEE to review current research needs on the fatigue of engineering structures and to survey existing research facilities, has been set up by the Council for Scientific and Industrial Research following an approach from the Institution of Civil Engineers. The committee will not include aircraft structures, reinforced concrete structures, or metal physics in the scope of their review, though information gained in these fields will be used.

# Equipment and Supplies

## Electric Enamelling Furnace

G. W. B. Furnaces, Limited, Dibdale Works, Dudley, Worcs., are marketing a batch-type vitreous-enamelling furnace (Fig. 1). One of these has been installed at the works of Izons & Company, Limited, in South Staffs, and is described in what follows. The furnace has been designed for long periods of continuous operation, and is robustly constructed. Its usable dimensions are: 9 ft. long by 4 ft. wide by 2 ft. high, and the normal operating temperature range is 600 to 900 deg. C., with a 1,000 deg. C. maximum. High-grade refractories line the heating chamber, which is constructed from specially-moulded element bricks supporting 80/20 nickel/chromium wire heating-elements around the walls and in the roof of the chamber. A small panel of elements is fitted to the inner face of the door in order to stabilize the chamber temperature rapidly after charging or discharging operations.

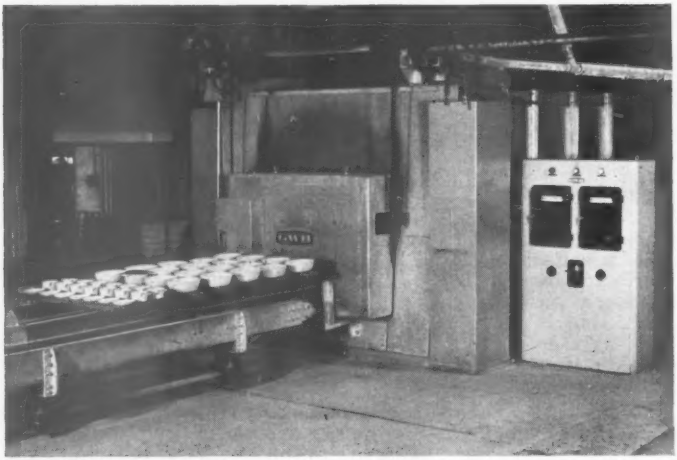

FIG. 1.—*Electric furnace for vitreous-enamelling cast-iron holloware, marketed by G.W.B. Furnaces, Limited, of Worcs.*

The average thickness of the wire elements is $\frac{3}{16}$ in. dia., and the mean dia. of the coils is $1\frac{3}{4}$ in. The method of continuous support reduces stress to a minimum, whilst the open structure permits a maximum dissipation of heat and does not introduce any complications arising from shielding, with its attendant high element temperature. The refractory fire-brick charge-supporting piers provide a firm base by reason of the retaining wall design of construction. Heating elements are fitted in these piers, suitably protected so that any accumulation of dirt forms on the bare refractory of the furnace hearth at the base of the piers, and is thus easily removable. The heating elements are claimed to have a long life, and are easily replaced. An operational life of ten years is not uncommon for the nickel/chromium alloy used. In considering the cost of electric heating it should not be forgotten that an electric furnace, operating from a three-phase supply, improves the load and power factors of the supply to a factory, which reduces the average price paid for the electricity supplied for other purposes. A rating of 150 kw. has been included in two independent zones covered by automatic controllers. These instruments are contained in the G.W.B. iron-clad switch-gear panel shown to the right of the furnace in Fig. 1.

At present no attempt is made to arrange automatic switching on and off of the plant. The equipment is switched on at 7.00 a.m. each morning, and off at 6.00 p.m. each night. After working the previous day, the equipment reaches the required temperature in 40 min. After being switched off for the weekend, from 6.00 p.m. Friday, the pick-up is such that it can be used after approximately 2 hr. on Monday morning. The working temperature is 760 deg. C., and the overnight temperature loss approximately 100 deg. C.

### *Charging Machine*

The charging machine, shown discharging a selection of "Anniversary Ware" from the furnace at the Izons works, was originally used with an earlier fuel-fired furnace, and has now been specially incorporated in the design of the present one. The machine is in two sections; the loading of the second section can be effected whilst the first load is being processed. This charging arrangement cuts to a minimum the time when the door is open. A typical load consists of $2\frac{1}{2}$ cwt. of holloware, which is in the furnace for a 30-min. cycle period. A quick "pick-up" of heat is essential for efficiency of operation and, to ensure this, the door gear-drive is specially designed for speedy raising and lowering. Also, the heating elements fitted to the inner face of the insulated refractory-lined door counter possible end heat losses, and rapidly stabilize thermal conditions within the chamber, so that a high degree of temperature uniformity is attained.

## Graphite Wash

A new product for use in the $CO_2$ Process is now available from Colloidal Graphite, Limited, Bernard Lane, Sheffield, 2. Known as Moldgraph, it is a dispersion of finely graded graphite, suitable for application to mould or die surfaces. The dispersion is in a fast-drying non-aqueous medium, so that application may be made direct to silicate-treated surfaces, such as are prepared in the $CO_2$ Process. The concentration of solid graphite content is sufficient to ensure an excellent coating with one application. The material is reported to be quite stable under ordinary conditions of storage, and slight sedimentation in storage can be rectified by shaking or stirring. The material is inflammable and should accordingly be stored with care.

A NEW MILD-STEEL PICKLING TANK is in the course of construction by Tanks & Linings, Limited, at the Shepcote Lane works of Firth-Vickers Stainless Steels, Limited, Sheffield. The 135 ft.-long tank is to be used to remove scale and prepare stainless-steel strip for further processing. It is lined with Velbex, produced by BX Plastics, Limited, of Higham Station Avenue, Chingford, London, E.4.

# American Letter

## Cast Low-alloy Steels*

The basic-electric steelmaking process permits of the refining of steel under oxidizing, neutral, and reducing conditions, and with adequate slag control produces good-quality steels. In the basic-electric practice, phosphorus is removed during the oxidizing period, and sulphur is removed primarily during the reducing period. Compared with other steel processes such as the basic-open-hearth, the basic-electric practice can produce cleaner steels of more uniform composition from poorer raw materials. The objectives during the oxidizing period are to reduce the carbon content of the steel, to produce a vigorous boil to intermix the slag and metal and aid in nitrogen and hydrogen removal, and to oxidize the phosphorous in the steel to calcium phosphate (which is ultimately removed in the deslagging operation). The objective during the reducing period is to reduce the sulphur content of the steel by forming a basic reducing slag containing 2-per cent. calcium carbide ($CaC_2$). Sulphur removal improves with increased slag basicity and higher bath temperatures.

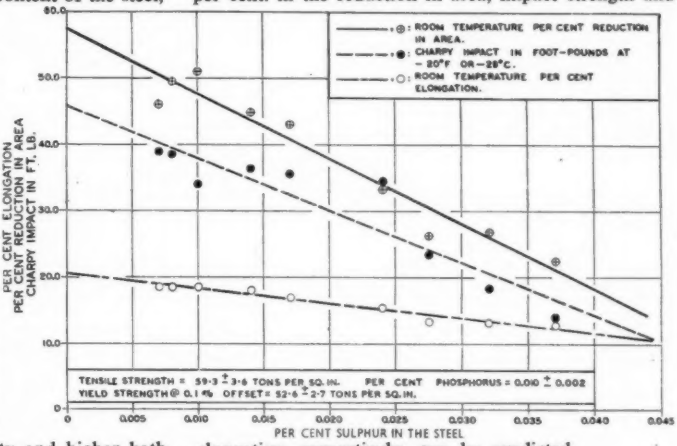
ROOM TEMPERATURE PER CENT REDUCTION IN AREA.
CHARPY IMPACT IN FOOT-POUNDS AT −20°F OR −28°C.
ROOM TEMPERATURE PER CENT ELONGATION.
PER CENT ELONGATION
PER CENT REDUCTION IN AREA
CHARPY IMPACT IN FT. LB.
TENSILE STRENGTH = 59·3 ± 3·6 TONS PER SQ. IN. PER CENT PHOSPHORUS = 0.010 ± 0.002
YIELD STRENGTH @ 0.1 % OFFSET = 52·6 ± 2·7 TONS PER SQ. IN.
PER CENT SULPHUR IN THE STEEL

FIG. 1.—*Effect of sulphur content on the physical properties of cast high-nickel 4325 steels. The strengths quoted are presumably in "short" tons per sq. in. (2,000 lb.).*

The effect of decreased phosphorus and sulphur content on the mechanical properties of low-alloy steel castings was studied, during the development of an operating procedure for producing low-phosphorus and low-sulphur steel in a nine-feet dia. basic-electric arc-melting furnace. This melting practice initially produced 4140 and high-nickel 4325 steel castings, with average sulphur and phosphorus contents of 0.010 per cent., and was later used to evaluate its effectiveness in producing 1040, 4330, and high-silicon 4340-type cast steels. Fig. 1 illustrates the effect of sulphur content on the reduction in area, elongation, and impact strength of the high-nickel 4325 steel castings. A reduction in the sulphur content was found to significantly improve the ductility and toughness, whilst maintaining a constant strength level. Extrapolating the percentage of sulphur to zero, and comparing the resulting physical properties with 0.030-per cent. sulphur steel, a maximum increase of 104.6, 105.8 and 45.7 per cent. in the reduction in area, impact strength and elongation, respectively, can be predicted.

* Synopsis of a paper, presented at the recent AFS Congress in Chicago (April 13 to 17), by John Zotos, who is metallurgist at the Rodman Laboratory, Watertown Arsenal, Watertown, Massachusetts.

## Steel Production-rate increases

Steel production, the bellwether of the metal industry, is proceeding at very nearly its 150,000,000-ton capacity rate in America. The January and February totals are approximately double those of the first two months in 1958. Activity in the USA metal industry is keeping in step with steel, and statistics indicate that the present production rate is 20 per cent. better than over-all 1958 rate.

## Colvilles to purchase Hurst, Nelson Works

Arrangements have now been concluded for the purchase by Colvilles, Limited, of the works of Hurst, Nelson & Company, Limited, wagon builders, etc., of Motherwell, from the parent company, Charles Roberts & Company, Limited, Horbury Junction, near Wakefield. The works are situated between Colvilles' Dalzell and Lanarkshire steelworks and are adjacent to the Ravenscraig Works.

Charles Roberts acquired the Scottish firm last year and at that time some 600 men were employed. Because of diminishing orders the labour force was reduced to about 300 and recently it was announced that the works would close in July.

Mr. Tom Craig, a director of Colvilles, said last week, that his firm had not decided about the future use of the Hurst, Nelson works, nor could he say how many people would be employed there. It was intended to develop the use of the site for purposes connected with Colvilles' interests.

## Encouraging Rise in Machine-tool Orders

Machine-tool orders rose both at home and overseas in February and the home demand at £4,527,000 was the highest for almost a year. Compared with January (£3,342,000) the increase was well over £1,000,000 and almost £1,000,000 better than in February, 1958.

Reports from the industry indicate that although it is not likely the trend will be found to have been maintained in March, April promises to be a good month for orders.

The recovery in exports from £1,103,000 in January to £1,253,000 in February was even more welcome as only once in the previous 12 months did export orders fall below the January figure. Export shipments during the month were almost the same as in January—£1,400,000—but home deliveries were £300,000 lower at £4,400,000. At the end of February the industry's order-book was £1,400,000 lower at £52,400,000—about £20,000,000 below a year ago.

## New Prices for Iron and Steel

Since the last general revision of maximum prices for iron and steel in March, 1958, there have been several changes in production costs. The cost of some imported iron and steel making materials has fallen, but other charges, notably railway rates and wages, have risen. There has on balance been a reduction, but this leaves out of account the fact that the fall in the volume of orders has led to many mills being operated below their most economical level. The Iron and Steel Board believe that savings could be achieved both in mill costs and in transportation if the size of individual orders were increased. They have therefore decided to reduce the maximum prices of steel in quantities of 10 tons and upwards (larger quantities for certain products) ordered to one specification for one delivery to one destination.

The reductions came into force on June 1, and those of interest to readers are shown in Table 1.

In general, no reductions are being made for quantities under 10 tons. There are increases for certain small quantity orders, and some size and quality extras are also being increased. The zone extras on basic pig-iron are reduced, as are the maximum prices of hematite and low-phosphorus foundry pig-irons.

The Board believe that the reductions for larger quantities now announced, which are of the order of 2 per cent. on the existing prices for such quantities, should help to strengthen the competitive position at home and abroad of those consumers who take advantage of them. No further changes in the general level of iron and steel prices determined by the Board, up or down, are in prospect.

TABLE 1.—*Principal Reductions in Maximum Prices According to Quantity.*

| Product. | Quantity. | Reduction per ton. |
|---|---|---|
| Basic pig-iron .. .. | Any quantity .. .. | Up to 10s. 0d. according to zone. |
| Hematite pig-iron .. | Any quantity .. .. | 12s. 6d. |
| Low-phosphorus foundry pig-iron | Any quantity .. .. | Varying amounts according to type and zone. |
| Wire rods, soft basic .. | 50 tons and over .. | 25s. 0d. |
| Other qualities.. .. | 50 tons and over .. | 20s. 0d. |
| | Under 50 tons to 20 tons.. | 15s. 0d. |
| | Under 20 tons to 10 tons.. | 10s. 0d. |
| Plates .. .. .. .. | 50 tons and over .. | 25s. 0d. |
| | Under 50 tons to 25 tons.. | 20s. 0d. |
| | Under 25 tons to 10 tons.. | 15s .0d. |
| Heavy bars, sections and joists | 50 tons and over .. | 15s. 0d. |
| | Under 50 tons to 25 tons.. | 10s. 0d. |
| | Under 25 tons to 10 tons.. | 5s. 0d. |
| Bright bars and flats: | | |
| Light sizes .. .. | 50 tons and over .. | 20s. 0d. |
| | Under 50 tons to 20 tons.. | 15s. 0d. |
| | Under 20 tons to 10 tons.. | 10s. 0d. |
| Heavy sizes .. | 50 tons and over .. | 15s. 0d. |
| | Under 50 tons to 20 tons.. | 10s. 0d. |
| | Under 20 tons to 10 tons.. | 5s. 0d. |
| Sheets, strip mill and and hand mill: | | |
| All types .. .. | 10 tons and over .. | 20s. 0d. |

IN THE BRITISH PAVILION at the Poznan International Fair (June 7 to 21), Wild-Barfield Electric Furnaces, Limited, of Watford, will be exhibiting a number of their standard products. A selection of standard laboratory muffles, a self-contained electrode salt bath (model ESB 69) and a resistance-heated vacuum-furnace for laboratory use (model 2904) will be displayed. The vacuum resistance furnace has been designed to enable research work to be carried out on special alloy-steels and other metals prior to full scale production in larger vacuum equipments.

## Joy-Sullivan Development

Joy-Sullivan, Limited, an American firm, established works at Cappielow, Greenock, in 1948, to manufacture mining equipment, and since the nationalization of the mines, it has had one big customer—the Coal Board. Until a year ago the company did very well indeed reaching a turnover of £3,000,000 a year, but recently, with the termination of the Board's mechanization plan, the works has experienced some recession and a certain amount of redundancy. This is being counteracted by the opening up of a new air-power division, which will draw upon the designs and "know-how" developed by the parent company in Pittsburg, USA. The range of plant to be made by the new division is wide and includes paving breakers and hard-rock mining machinery. A leaflet describing a compressor states that the frame of the unit is "semi-steel," which sounds a little old-fashioned to the foundry industry of this country. Light-weight aluminium pistons are used. Another interesting feature is that the box-type crossheads are made from heat-treated alloy iron and again "semi-steel" is used for the cylinders and cylinder-heads. Also of interest is the statement "providing uniform wall thickness, the cylinder and crosshead liners are replaceable and are not an integral part of the cylinder or frame."

Foundry owners and patternmakers should have a real interest in establishing contact with a firm developing a new-to-this-country range of machinery incorporating a substantial quantity of castings.

## CEGB places Contracts Worth £13,500,000

Contracts for power stations, transmission lines, and transformer stations, amounting to some £13,500,000, were announced last Wednesday by the Central Electricity Generating Board. Among the principal contracts, C. A. Parsons & Company, Limited, will supply transformers for the Boldon, Lackenby, and Hart Moor sub-stations, and the General Electric Company, Limited, will supply protective gear for the Ffestiniog power station, and transformers and switchgear for the Plymouth North and Willenhall sub-stations. Sir William Arrol & Company, Limited, is to supply structural steelwork for the Belvedere power station and Richard Costain, Limited, Birtley Engineering, Limited, and A. Reyrolle & Company, Limited, have won contracts for the West Thurrock power station.

Other companies to whom contracts have been awarded include:—Sulzer Bros. (London), Limited; Sir Robert McAlpine & Sons, Limited; Yarrow & Company, Limited; J. L. Kier & Company, Limited; Hackbridge & Hewittic Electric Company, Limited, and British Thomson-Houston Company, Limited.

### Latest Foundry Statistics

*Light-alloy Castings.* The Ministry of Supply has issued the following production figures for the month of February. Aluminium-alloy castings made from sand moulds totalled 1,546 tons; as gravity-die, 3,846 tons, and as pressure-die-castings, 1,591 tons—so now sand castings go to the bottom of the list. The output of magnesium castings was 143 tons.

GENERAL REFRACTORIES B TEAM, of Deepcar; Wentworth Silkstone; and South Kirkby tied for first place in the annual competitions of the Wombwell Divisional St. John Ambulance Brigade, on May 23. The three captains cast lots for the Elliott Memorial Cup which went to General Refractories.

# Dimensionally-Accurate Castings

*(Section devoted to the technology of producing castings to close tolerances)*

# BICTA's First Conference

**The first annual conference of the British Investment Casters' Technical Association was held in London on May 11 and 12, and was attended by over 60 representatives of some 28 organizations in membership of the Association, or closely allied to the industry. Prior to the opening of the conference, the formal annual general meeting was held under the chairmanship of Mr. D. H. Armitage (attached to P.I. Castings (Altrincham), Limited), when the first annual report was adopted.**

## ANNUAL REPORT

The inauguration of the Association at a meeting held at the Charing Cross Hotel, London, W.C.2, on June 11, 1958, which was attended by representatives of twenty-five companies engaged in the investment casting and allied industries, followed a period of over twelve months' inquiry and negotiation within the industry. The value of a forum for the exchange of technical information had been recognized, and accepted by the large part of the industry which had participated in a previous series of international conferences attended by many European and some American investment founders. The move to create the British Investment Casters' Technical Association undoubtedly emerged from those meetings. It is gratifying to report that approximately 50 per cent. of the industry has immediately taken up membership, and that twelve of the principal companies supplying materials to the industry are giving their valued support through Associate Membership.

The Council is confident that the programme of activities which has been prepared during the past few months, and which will become fully effective in the coming year, will induce several more companies to participate in the vital objectives of the Association. These are primarily to publicize the industry and its products amongst an ever widening circle of user interests; and to foster technical co-operation amongst investment founders with the object of ensuring that the highest standards of quality are attained and maintained in the supply of engineering components as investment castings.

Announcements of the Association's inauguration were published in 40 periodicals in 14 countries of the world.

### The Council

Those who had acted as an exploratory committee and provisional Council prior to the formal commencement of the Association were re-elected at the inaugural meeting to form the first Council, namely: Mr. D. H. Armitage (P.I. Castings (Altrincham), Limited), Mr. R. W. N. Danielsen (Deritend Precision Castings, Limited), Mr. W. Foyers (H & F Precise Castings (1959), Limited), Mr. G. A. Tomkinson (D. Napier & Son, Limited), and Mr. N. Walker (Hadfields, Limited). At the Council's first meeting Mr. Armitage was elected chairman and Mr. Danielsen vice-chairman. In accordance with paragraph 14 of the Constitution adopted at the inaugural meeting Mr. Danielsen and Mr. Foyers will retire at the annual general meeting in 1959 and, being eligible, offer themselves for re-election. Mr. Tomkinson and Mr. Walker will retire in 1960 and will similarly be eligible for re-election. Eight meetings of the Council have been held in the nine months ending March 31, 1959.

### Secretarial Facilities

Prior to the inaugural meeting, the exploratory committee had made contact with the British Steel Castings Research Association regarding the possibility of their providing secretarial services and accommodation for the Association, and proposals along these lines were put to and accepted by the inaugural meeting. The Council has pleasure in reporting that the arrangements have proved entirely satisfactory. The Association has been able to function in complete freedom whilst enjoying the facilities and experience of an established technical secretariat. Meetings of the Council and committees have been accommodated at the Association's headquarters at East Bank Road, Sheffield, as required; and an independent address has been established for the Association. The Council gratefully acknowledges the assistance given by the British Steel Castings Research Association, and, in particular, by Mr. John Bolton, who has acted as secretary.

### Constitution

At the inaugural meeting the Constitution submitted by the exploratory committee was adopted with a request that the Council should examine

*The chairman, Mr. D. H. Armitage (of P.I. Castings (Altrincham), Limited) and Mrs. Armitage (right-hand side) receiving Mr. F. Hudson, F.I.M. (Mond Nickel Company, Limited) and Mrs. Hudson before the annual dinner of the British Investment Casters' Technical Association.*

and report to the first annual general meeting on the following two matters:

(*a*) the desirability of amending the definition of the industry in paragraph 2 of the Constitution, since this appeared to exclude investment processes using permanent patterns, and the jewellery and dental trades; and

(*b*) the desirability of Associate members having representation on the Council.

Both these matters have been most carefully considered by the Council which recommends:

(*a*) that the definition of the industry in Clause 2 of the Constitution adopted at the inaugural meeting on June 11, 1958, should not be amended; and

(*b*) that provision should be made for Associate members to elect their own representatives on the Council.

The Council has made arrangements to submit to the first annual general meeting a resolution giving effect to the latter recommendation.

### Membership

The first members of the Association were those companies who completed formal applications for membership in advance of or at the inaugural meeting on June 11, 1958. It has been a matter of very great regret to the Council that Joseph Lucas, Limited, decided to close their investment foundry as at December 31, 1958. This inevitably led to that company's withdrawal from the Association, and threatened to deprive the membership of its valued connection with Dr. J. D. Jevons of that company. In view of Dr. Jevons' personal interest in our affairs, and the outstanding service which he rendered in the formative period of the Association, the Council unanimously decided to elect him an honorary member.

Deloro Stellite, Limited, and Preformations, Limited have been elected full members, and the Mond Nickel Company, Limited, and A.P.V.-Paramount, Limited, have been elected associate members, since the inaugural meeting. Close Tolerance Castings, Limited, have resigned from membership.

### Finance

Arrangements have been made with the Board of Inland Revenue that members' subscriptions to the Association are allowable as an expense not subject to income tax; and in order to reduce the Association's own liability to income tax the balance of income over expenditure at March 31, 1959, was apportioned amongst the membership and repaid to them at that date, and recalled by the Association on April 1, 1959.

The Council appointed Peat, Marwick Mitchell & Company as auditors to the Association until the first annual general meeting.

## COMMITTEES OF THE COUNCIL

A programme of technical activities to be carried out through committees appointed by the Council from the membership of the Association was announced to members in October and November 1958. The response was encouraging and six committees, were established with terms of reference as follows:—

*Metal Specification*

(*a*) To co-ordinate comments from BICTA members on British Standards and such other specifications as may be issued to the investment castings industry for comment, with a view to presenting the industry's case in the strongest possible manner to the issuing authority.

(*b*) To gather from the members particulars of their requirements for future British Standards.

(*c*) Periodically to review specifications for investment castings with a view to putting forward such amendments as may be found necessary by experience.

(*d*) To undertake correlations of existing material specifications in use in the industry with a view to promoting the use of the British Standards for investment castings as they are issued.

*Technical Publicity*

(*a*) To seek all possible means of bringing the technical advantages of investment castings to the notice of users and potential users.

(*b*) To encourage members to make technical editorial information available to enhance the prestige of the industry generally, with a view to extending the field of application of investment castings.

*Industrial Health and Safety*

To identify and assess the hazards to health and safety peculiar to investment founding;

and to make arrangements for the industry to be advised on measures that may be taken to avoid or reduce such hazards.

*Industrial Statistics*

To compile information on the investment castings industry: the production processes employed, the alloys cast, the markets served, the raw materials used, and the elements of production costing of castings.

*Pattern Production*

(*a*) To make a review of practices and materials currently used in the industry; and to assess new materials available to the industry.

(*b*) To seek to establish standards of quality, and means of testing pattern materials.

(*c*) To advise the industry on the practicability of reclaiming used pattern wax.

*Diemaking*

To make a review of practices and materials currently used in the industry; to assess new materials available to the industry; and to bring new techniques to the notice of the industry.

It has not proved possible to launch all of these committees during the three months before this meeting, but the Metal Specification, Technical Publicity, Industry Statistics, and Industrial Health & Safety, committees have all commenced work, and the first two have already achieved important results. The Council acknowledges the assistance which has been given by the chairmen and the members of these committees, and places on record the Association's indebtedness to the member companies who have made members of their staff available for these purposes.

### Metal-specification Committee Work

This committee, under the chairmanship of Mr. G. A. Tomkinson of D. Napier & Son, Limited, has ensured that all members of the Association have had the opportunity of considering, in draft, Part I of the proposed British Standard for Investment Castings in Metal. Furthermore, the committee undertook the difficult and important task of correlating the diverse comments received, so that a unified and therefore more effective reply was submitted to the appropriate committee of the British Standards Institution. The committee recognizes that the investment-castings industry faces peculiar problems of its own in relation to the acceptance of materials specifications. In so far as the industry was very largely created as a supplier to the aircraft industry, it has been accustomed to producing precision investment-castings to the highest standards of quality, and to the most rigid inspectional requirements. But with its continued development into as many as 100 other branches of industry, different commercial and technical considerations apply, and investment castings come into competition with other forms of fabrication. Whilst high standards of dimensional accuracy, soundness and surface finish are attained by investment-casting, the investment founder cannot accept more stringent specificational requirements for his products than would apply to other forms of fabrication. Particularly does this apply to the supply of non-stressed components. The comments submitted by the metal-specification committee on the draft British Standard have reflected these views, and it is hoped that, with the strong representation which the Association has both directly and indirectly on the British Standards Committee ISE/60, these views will prevail to the ultimate advantage of both the industry and its actual and potential customers.

The committee is arranging to put forward to the British Standards Institution the members' views on the ranges of material which should be included in subsequent sections of the British Standard for Investment Castings in Metal, and may well become the medium for the collection of data from the industry on the properties of materials in investment-cast form.

### Technical Publicity Committee Work

Three meetings of the technical publicity committee have been held under the chairmanship of Mr. N. Walker of Hadfields, Limited, and notable progress has been made in four main directions. Arrangements have been made to collect from members particulars of interesting applications for investment castings, so that sequences of case histories may be released to the technical press to form a continuous and effective means of bringing the advantages of investment castings to the notice of would-be users. Secondly, material in the form of a lecture script and a comprehensive range of specimen castings is being prepared, that lectures may be offered to local engineering societies and other suitable audiences, the lecturing being shared amongst the staffs of member companies. The provision of this lecture material should greatly reduce the burden that an extended lecture programme

*(From left to right) Mr. G. A. Tomkinson (D. Napier & Son, Limited) and Mrs. Tomkinson, with Mr. H. W. Ridgeway (Colin Stewart, Limited) and Mr. R. W. N. Danielson (Deritend Precision Castings, Limited), after the official reception.*

*Mr. A. E. Thornton (Firth-Vickers Stainless Steels, Limited) and Mrs. Thornton, photographed while attending the BICTA annual dinner in London.*

might otherwise impose on some of the smaller companies, and will also ensure a uniformly high standard of presentation of the subject matter.

The committee has taken the initiative in sponsoring an exhibit at the Minibition of the Purchasing Officers Association, which is to be held at Folkestone from September 24 to 26, 1959. This unique form of exhibition is attended by a very large number of purchasing officers, and provides an economical way of bringing the potentialities of our product to their notice. With the same purpose in mind the committee has made an exhaustive review of buyers guides and directories, which ought to include the names of full members of the Association. It has been found that in many cases incomplete lists of the names of investment founders appeared under inadequate classifications, and the publishers have been notified accordingly.

### Industrial Statistics Committee Work

Little or no factual data exists on the extent and nature of the investment-casting industry. This is clearly to its disadvantage, for not only are the individual manufacturing units unable to gauge their own activities in terms of those of the industry as a whole, but the Association is unable to present quantitative information which in a wider sense could add to the prestige of the industry. Until basic information is available, and means established for the regular collection and analysis of such data, the industry will be handicapped in taking collective action in many important directions. The industrial statistics committee, of which Mr. W. S. Fowkes, H. & F. Precise Castings (1959), Limited, is chairman, is carefully considering the type of data that should be collected, and the uses that may ultimately be made of them with a view to the issue of suitable questionnaires in due course. In this connection the committee and the Council have received invaluable assistance from the Investment Castings Institute of America, who have provided full information on corresponding activities, which they have pursued advantageously for a period of almost five years.

## OTHER MATTERS

### External Relations

Cordial relations have been established and maintained with European investment founders through Mr. Meerkamp van Embden, and the Association has nominated authors of papers for the European Investment Founders' Conference at Essen, which is to be held from May 31 to June 4, 1959. Proposals from Mr. Meerkamp van Embden for a more formal European organization have been carefully considered by the Council, but in general it is considered that an annual conference provides the most effective practicable means of co-operation under present circumstances.

Reference has already been made to the help which the Investment Castings Institute of America has given in the provision of information for the industry statistics committee, but their co-operation has by no means been confined to that field. The Council is indeed grateful to the Institute for so willingly placing information on their procedures and experience at the disposal of the Association.

The Council has established contact with appropriate government departments, including the Ministry of Supply, the Admiralty and H.M. Inspectorate of Factories. It is pleased to report that Mr. L. R. Beesly, M.I.MECH.E., director of engine production, Ministry of Supply, has accepted their invitation to be the principal guest at the first annual dinner of the Association, which will be held in London on May 11.

In addition to effecting direct representation on committee ISE/60 (Investment Castings in Metal) of the British Standards Institution, through the appointment of Mr. L. S. Taylor (G. L. Willan, Limited) and Mr. N. Mason (Deritend Precision Castings, Limited), the Association has appointed Mr. G. A. Tomkinson (D. Napier & Son, Limited) to represent members on BSI committee SGC/18 (Surgical Implants).

### Library and Publications

A library service for members of the Association has been provided by the British Steel Castings Research Association on a voluntary fee-paying basis. Most members of the Association have taken advantage of this scheme, under which participants receive in alternate months an issue of *Investment Castings Abstracts*. Five issues of this publication have been brought out so far, containing summaries of 85 published items relating to investment founding throughout the world. Bibliography No. 1, comprising over 70 references to British Patents of interest to investment founders, has also been issued during the year.

### Conclusion

The Council is confident that, with the continued support of members, the promising start which has been made by the Association will be consolidated

in the next few years, and that the Association will play an effective part in helping to establish the industry on a very much broader front than hitherto.

On behalf of the Council,
D. H. ARMITAGE,
Chairman.

## APPENDIX I

### BICTA Membership

(As at the commencement of the annual meeting)

*Honorary Member*
Dr. J. D. Jevons (Joseph Lucas, Limited).

*Full Members*
Birmingham Small Arms Company, Limited.
Deloro Stellite, Limited.
Deritend Precision Castings, Limited.
Firth-Vickers Stainless Steels, Limited.
Hadfields, Limited.
H. & F. Precise Castings (1959), Limited.
D. Napier & Son, Limited.
P.I. Castings (Altrincham), Limited.
Preformations, Limited.

*Associate Members*
A.P.V.-Paramount, Limited.
Astor Boisellier & Lawrence, Limited.
Chambers Bros., Limited.
Claud Campbell & Company, Limited.
W. J. Hooker, Limited.
Mond Nickel Company, Limited.
Monsanto Chemicals, Limited.
Samuel Osborn & Company, Limited.
Refractory Mouldings and Castings, Limited.
Colin Stewart, Limited.
Wilkins, Campbell & Company, Limited.
G. L. Willan Limited.

## ANNUAL MEETING

In presenting the Report, Mr. Armitage stressed considerable advances which had been made in less than the one year which had elapsed since the Association had been formed, and mentioned in particular the activities of the technical committees dealing with metal specifications, technical publicity and industrial statistics, which had already become active and achieved significant results. Other technical committees on industrial health and safety, patternmaking and die-making had been established and were expected to start work in the immediate future.

### Election of Officers

The members of the Council retiring by rotation at the annual general meeting, namely Mr. R. W. N. Danielsen (Deritend Precision Castings, Limited) and Mr. W. Foyers (H. & F. Precise Castings (1959), Limited), were re-elected, and following an amendment of the Constitution to permit the class of associate member to be represented on the Council, Mr. A. Dunlop (W. J. Hooker, Limited) and Mr. L. S. Taylor (G. L. Willan, Limited), were elected for this purpose. Votes of thanks to the chairman and to the Council were cordially received and carried by acclamation.

### Dinner

On the evening of Monday, May 11, the first annual dinner of the Association was held, when the chairman of the Association presided over a company of some 85 members and their ladies,

*Annual dinner of the British Investment Casters' Technical Association held at the Connaught Rooms, London, on the Monday. It was attended by 85 members, guests and ladies, the principal guest being Mr. W. L. Beesly, director of engine production, Ministry of Supply.*

*BICTA's First Conference*

whose principal guest was Mr. W. L. Beesly (director, engine production, Ministry of Supply), who was accompanied by Mrs. Beesly. Others at the top table were Mrs. Armitage, Dr. and Mrs. J. D. Jevons, Mr. Meerkamp van Embden, Dr. A. H. Sully (director, British Steel Castings Research Association) and Mrs. Sully, and Mr. and Mrs. R. W. N. Danielsen.

The loyal toast having been honoured, the toast of the Investment Casting Industry and the British Investment Casters' Technical Association was proposed by Mr. Beesly. After complimenting the Association on the rapid progress which it had made in establishing itself as an effective technical organization for investment founders, he referred to the close links which the industry had had, and would continue to have, with the aircraft industry. Investment founders would need to make a continuous study of new melting- and casting-techniques which might lead to further improvement of their products; and if they were to meet competition from fabrication they would need to give even more attention to dimensional accuracy of castings, especially on joint-lines. Mr. Beesly went on to say that although the aircraft industry might be a hard task-master for its suppliers, it had also been instrumental in promoting progress in many diverse fields: in technical education and apprentice training; in attracting high-quality scientific and professional staff to many branches of industry; in developing a wide range of molten alloys and non-metallic materials, and in developing and establishing numerous inspection methods.

The response to Mr. Beesly's toast was made by the chairman of the Association, who also proposed the toast of "The Guests." In the course of his speech Mr. Armitage acknowledged the substantial help which the industry had received from Mr. Beesly, the Ministry of Supply, and the aircraft industry generally, and went on to refer to the ever increasing outlets which were being established for investment castings in general engineering industries. He also welcomed Mr. Meerkamp van Embden, whose hospitality so many British investment-founders had enjoyed at the several European Conferences over which he had presided. He took the opportunity also of placing on record the deep appreciation which members felt for the work which Dr. Jevons had done during the formative period of the Association. Finally, Mr. Armitage said that he was very pleased to welcome Dr. and Mrs. Sully. The rapid development of the Association was, he said, in large measure due to the services which had been placed at its disposal by BSCRA, of which Dr. Sully was the director. The arrangements between the two Associations covering secretarial services and accommodation had worked successfully and effectively, and he and the members were most grateful for these facilities, and particularly to Mr. John Bolton the secretary.

The response to the toast of The Guests was made by Mr. Meerkamp van Embden, who congratulated the Association on its programme of activities.

**Conference Sessions**

The Conference proper was opened at 3.45 p.m. on the Monday by Mr. Armitage who, after welcoming Mr. H. J. Meerkamp van Embden, Philips' Gloeilampenfabrieken, president of the European Investment Casters' Association, and representatives of a number of non-member investment foundries, praised the support which members had given to the Council, thus making possible the holding of a technical conference so soon after the date of inauguration.

Mr. Armitage continued by saying that, as the time had approached for the annual meeting, the Council had debated at some considerable length the possibility of running a short technical conference at the same time. So early in the Association's history it was considered to be a very ambitious thing to attempt, particularly as, whilst some of the technical committees had already been very active, they were obviously not yet at a stage of providing reports for discussion. This proposal had been put back to members, and a request for technical papers made, with the first-class results seen in the papers to be presented.

Mr. Armitage then said that, having given an occasional lecture himself, he knew the sheer hard work that was necessary in the preparation of a paper, and that he was sure that all present were grateful to the individual authors, and their companies for allowing the information to be published. He continued by recalling that, when he was attending a technical session in America a few years previously, he had stood on his feet to agree with some remarks that a lecturer had made, quoting supporting evidence from his own experience. He had been very rudely interrupted by the chairman, who had spoken words to this effect: "You know, we are only really interested in hearing from you if you disagree with what has been said." Mr. Armitage said that he disagreed with this attitude, and would prefer members to speak out freely, whether or not they agreed with the author's statements.

Mr. Armitage then invited the vice-chairman of the Association, Mr. Danielsen, to take the chair at the first technical session, to which a paper "Investment Castings and some Aspects of their Costs" was presented for discussion by Mr. W. S. Fowkes (H. & F. Precise Castings (1959), Limited). (This paper and a report of the discussion will appear in a forthcoming issue of the JOURNAL.)

The conference programme on Tuesday, May 12, consisted of three technical sessions commencing at 9.15 a.m. and continuing until 4 p.m., with a short adjournment for lunch. At the first of the morning sessions, which was presided over by Mr. G. A. Tomkinson (D. Napier & Son, Limited), two papers were presented: "Investment Casting Alloys for Service at Elevated Temperatures," by Mr. D. R. Wood (Mond Nickel Company, Limited) (Mr. Wood's paper is given in full after the "First Annual Report"); and "Mechanical Properties of some Investment-cast Cobalt-base Alloys," by Mr. M. Riddihough (Deloro Stellite, Limited). The second session Mr. N. Walker (Hadfields, Limited), in the chair, was devoted to a paper on "Atmospheric

(*Continued on page 668*)

# Investment-cast Alloys for High-temperature Service*

*By D. R. Wood†, M.A., A.I.M.*

**Recent developments in high-temperature engineering have intensified the demands made upon constructional materials of many types. The current requirement is for strength over long periods at elevated temperatures, and in some cases provision must be made for service involving corrosive environments. To meet these conditions a range of new materials has been developed, and in this connection cast alloys are becoming increasingly important. The aim of this paper is to review some of those which are available in investment-cast form, giving consideration to certain factors which govern the choice of alloys for specific types of application.**

A large proportion of investment castings made in high-temperature alloys are for use in aircraft-gas-turbines; for example, the majority of British, and many foreign, aero-engines incorporate investment-cast inlet vanes and stator blades. For these applications corrosion resistance and resistance to thermal fatigue are perhaps the most important factors. Rotating blades, for which wrought alloys are generally favoured, call particularly for materials having high resistance to creep, whilst in integrally-bladed discs fluctuating temperature gradients demand adequate ductility. In diesel-engine pre-combustion chambers, which may also be investment-cast in high-temperature alloys, the need is for resistance to corrosion and to thermal fatigue.

## Available Alloys

This paper makes no attempt to give an exhaustive review of all the numerous high-temperature casting alloys which have been proposed; the aim is rather to classify the materials according to types, quoting examples of those alloys which have either a long record of useful service, or potentialities of particular interest. Practical development has centred on alloys based on iron, cobalt or nickel, or on a combination of these metals; typical compositions are listed in Table 1.

*Heat-treatment*

It is noteworthy that in every one of these alloys chromium is present as a major alloying element, its principal function, apart from contributing to high-temperature strength, being to enhance corrosion resistance at elevated temperatures. Additions of tungsten, niobium and other selected elements further increase the hot strength, but the mechanisms of strengthening vary somewhat according to the composition of the alloys. For example, neither the iron-base alloys, nor the carbide-type nickel-base alloys such as Nimocast 242, age-harden strongly. Some advantage can be taken of age-hardening the cobalt-base alloy X40, but the nickel-base alloys such as Nimocast 90 respond markedly to heat-treatment. The highest properties are obtained in the solution-treated and aged condition, the improvement being due to the precipitation of the phase $Ni_3$ (Ti, Al). On the other hand, the most highly-alloyed compositions, such as Nimocast 258, though amenable to age-hardening, normally develop high properties in the as-cast condition.

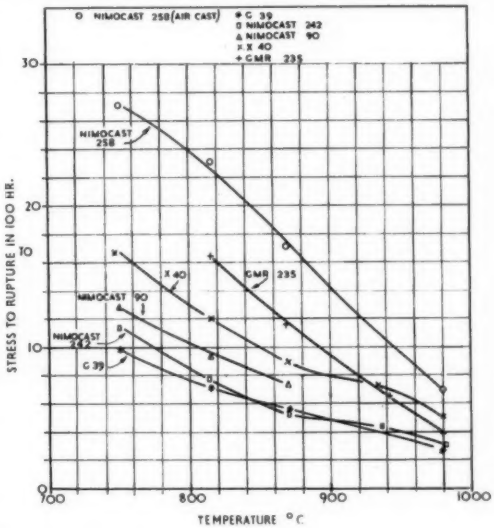


FIG. 1.—*Graph of* 100-*hr. rupture stress* versus *temperature* (*published data*).

## Mechanical Properties

In high-temperature engineering major interest centres upon short-time tensile properties, and on stress-rupture, creep and fatigue properties over extended periods. Published data, which have been derived mainly, if not exclusively, from tests on specially-cast bars, are compared in Tables 2 and 3, and in Fig. 1. The room-temperature tensile-strength properties of the alloys (see Table 2) cover a

* Paper presented at the First Annual Conference of The British Investment Casters' Association, which was held at Connaught Rooms, London, on May 11 and 12.

† Mr. Wood is on the staff of Mond Nickel Company, Limited, of London. Particulars of his career are recorded on page 668.

*Investment-cast alloys*

range of approximately 30 to 60 tons per sq. in., although the highest levels are obtainable only at some sacrifice in ductility. It is noteworthy, however, that these alloys retain a high proportion of their tensile strength at temperatures up to at least 700 deg. C., as illustrated in Figs. 2 and 3. The ductility values are given in Fig. 4.

Results of short-time tensile tests are inadequate as a criterion of behaviour in service involving prolonged exposure to stress and temperature, but measurements of life to rupture over a prolonged period provide a more realistic approximation. Values for 100-hr. life have proved useful, and the data in Table 2, compiled on that basis, show how the stress-carrying capacities of the alloys vary with temperature. The iron-base alloys retain a useful strength (say, 7 tons per sq. in. for a 100-hr. life to rupture) up to 750 deg. C.: for the cobalt-base alloys this degree of strength is maintained to approximately 900 deg. C., and for the strongest of the nickel-base materials the equivalent temperature is approximately 1,000 deg. C.

A great deal of interest attaches to the other nickel-base alloys having high-temperature strength at least equal to that of Nimocast 258. Among such alloys which have already been proposed are those known as G.64[16], Inconel 713C[17], D.C.M.[18] and Nicrotung.[11, 18] Further development of such materials is likely, and in exploiting their high-strength potentialities it is essential to secure a satisfactory combination of castability, particularly-good feeding characteristics, strength, ductility, resistance to embrittlement in service, and resistance to corrosion.

It is an interesting feature that some of the alloys, such as Nimocast 242 and G.39, although showing relatively low strength at moderate temperatures, *e.g.* at 750 deg. C., retain much of this strength at higher temperatures (see Fig. 1). Similarly, the relative strengths of different materials may vary with time, as shown in Fig. 5.

Notwithstanding the dearth of strictly comparable test data, some idea of the fatigue strengths of five of the alloys under discussion can be gained from Table 3. It is of interest that while the cobalt-base alloy X40, and the nickel-base alloy Nimocast 258, have approximately equal fatigue strength at 815 deg. C., the latter has much the higher rupture strength at the same temperature (see Table 2).

TABLE 1.—*Typical Cast Alloys for High-temperature Service.*

| Type of alloy. | Commercial forms. | Composition (per cent.). | | | | | | | | | Reference. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Fe. | Co | Ni | Cr | Other elements. | | | | | |
| Fe base | G. 18B | 54* | 10 | 13 | 13 | C 0.4 | Nb 3.0 | W 2.5 | Mo 2.0 | | 4 |
| | WF.176 | 50* | 7.5 | 18 | 18 | C 0.12 | Nb 1.0 | W 2.0 | Mo 3.0 | N 0.15 | |
| | HR Crown Max | 60* | — | 12 | 23 | C 0.2 | Si 1.2 | W 3.0 | | | 6 |
| Co base | HS.31 (X40) | 2 max. | 55* | 10.5 | 25.5 | C 0.5 | W 7.5 | | | | 1 |
| | S-816 | 2 | 45* | 20 | 20 | W 4 | Mo 4 | Mn 1.2 | Nb+Ta 2 | | 7 |
| | G.34 | 17 | 45* | 12 | 19 | Mo 2.0 | Nb 1.2 | V 2.8 | | | 2 |
| Ni base | Nimocast 242 | 1 max. | 10 | 60* | 20 | C 0.3 | Mo 10 | | | | 8 |
| | G.39 | 3 | — | 66 | 20 | C 0.5 | Mo 3.0 | W 3.0 | Nb 1.5 | Ta 1.5 | 9 |
| | Nimocast 90 | 5 max. | 16 | 55* | 20 | C 0.1 | Ti 2.4 | Al 1.2 | | | 6 |
| | GMR-235 | 10 | — | 63* | 15.5 | Mo 5.2 | Ti 2.0 | Al 3.0 | B 0.06 | | 10 |
| | Nimocast 258 | 2 max. | 20 | 54* | 10 | C 0.22 | Mo 5.0 | Ti 3.7 | Al 4.8 | B 0.01 | 8 |

* Balance, approximately.

## Corrosion Resistance

The data in Table 4 were determined under conditions sufficiently similar to permit a broad comparison. The general picture is that the scaling rates of the alloys increase with rising temperature. The iron-base alloy oxidizes quite rapidly at 870 and 950 deg. C.; the two cobalt-base alloys show lower oxidation rates up to 870 deg. C. The nickel-base alloys G.39 and Nimocast 90 show high resistance to oxidation at all temperatures up to 1,050 deg. C., and Nimocast 242 has good resistance up to at least 950 deg. C.

*Tests with Sulphur*

Risk of accelerated corrosion due to sulphur may arise in many service conditions in which components are exposed for extended periods at high

TABLE 2.—*Tensile and* 100-*Hr. Rupture Data.*

| Alloy. | Tensile properties at 20 deg. C. | | | | Casting technique. | Stress (tons per sq. in.) producing rupture in 100 hr. at deg. C. | | | | | | Reference. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0.1 per cent. proof stress. | 0.2 per cent. proof stress. | U.T.S. (tons per sq. in.). | E (per cent.). | | 650 | 750 | 815 | 870 | 940 | 980 | |
| WF.176 .. .. | 19 | — | 32-38 | 10 | Air .. .. .. | (19) | (9) | | | | | 8 |
| HR Crown Max. .. | — | — | 40 | 30 | ,, .. .. .. | (12) | (7) | | | | | |
| H8.31 (X40) .. | | 34 | 48 | 9 | Air, as cast .. .. | 25 | (17) | 12 | 8·9 | (6·5) | 5·0 | 1 |
| | | 50 | 57 | 2 | Air: aged. 50 hr. at 730 deg. C. .. | | | 12·8 | | | | 1 |
| S-816 .. .. | | | | | Air .. .. .. | | | 12·3 | 8·7 | | 4·9 | 7 |
| G.34 .. .. | 26 | | 40 | 2.5 | ,, .. .. .. | | 17 | 11·6 | 8·3 | 4·5 | 3·5 | 8 |
| Nimocast 242 .. | 17 | 19 | 31 | 8 | Air .. .. .. | | 11·7 | 7·5 | (5·3) | 4·3 | 2·8 | |
| G.39 .. .. | — | — | 33 | 5 | ,, .. .. .. | 17·0 | 10·0 | (7·2) | (5·5) | | (3·0) | 9 |
| Nimocast 90 .. | 33 | 34 | 45 | 14 | ,, .. .. .. | | 13·0 | (9·5) | 7·5 | | | |
| GMR.235 .. | — | — | 47 | 10 | Vacuum .. .. | | | 10·5 | (11·7) | (6·5) | 4·0 | 10 |
| Nimocast 258 .. | 49 | 51 | 55 | 3.4 | Air .. .. .. | | 27 | 23 | 17 | | 7·7 | |
| | 49 | — | 59 | 7.9 | Vacuum .. .. | | | | | | 7·5 | |

( ) Interpolated values.

temperatures. In laboratory tests[12], using a sulphur-containing gaseous atmosphere, several iron-base alloys and one nickel-base alloy showed no excessive corrosion at temperatures up to the normal limit of oxidation resistance. The presence of solid sulphates likewise proved to be not seriously damaging, but when even small amounts of alkaline chlorides were present severe attack occurred. For some purposes, a useful indication of resistance to this form of corrosive attack is given by a test involving part-immersion of a sample of alloy in molten sodium-sulphate containing a small proportion of sodium chloride, with subsequent cleaning and measurement of weight loss. Some success has

TABLE 3.—*Fatigue Data (Rotating Bend Tests).*

| Alloy. | Mean stress (tons per sq. in.) causing fracture. | | | Reference. |
|---|---|---|---|---|
| | 650 deg. C. $10^8$ cycles. | 815 deg. C. $10^8$ cycles. | 870 deg. C. $15 \times 10^8$ cycles. | |
| H8.31 (X40) .. | ±25 | ±20.7 | | 1 |
| G.34 .. .. | | (±10.5) | (±10) | 8 |
| G.39 .. .. | | (±9) | (± 9) | 8 |
| Nimocast 258 (Air) | | (±17.5) | ±21 | |
| Nimocast 258 (Vacuum) | | (±19) | ±21 | |

( ) Interpolated values.

thus been achieved in predicting the service behaviour of wrought alloys.

### *Corrosion by $Na_2So_4$/NaCl Mixtures*

The test results given in Table 5 show that the cobalt-base alloy X40 is strongly resistant to attack by a dilute mixture (0.5 per cent.) of sodium chloride in sodium sulphate. The corrosion rate is higher at a sodium-chloride concentration of 25 per cent. The nickel-base alloy Nimocast 258 is somewhat more resistant to attack by both media. Alloys are known, *e.g.* a modified Nimocast 258 (see Table 5), which show much higher resistance to this form of corrosion, but unfortunately this improvement is at the expense of high-temperature strength. Promising possibilities exist of obtaining increased protection by coatings such as chromium, but there is a widespread desire for alloys of homogeneous corrosion-resistance, and the problem of high strength with good corrosion-resistance at high temperature demands further research.

## Thermal Fatigue

A problem which frequently confronts engineers working with high-temperature materials is that of a type of cracking which is attributed to thermal fatigue. It is postulated that such cracking is intensified by differential stressing set up periodically by rapidly-changing temperature gradients, and it is, therefore, clear that design of components and operating conditions will critically affect susceptibility. It is, likewise, not surprising that attempts to correlate resistance to thermal fatigue with the physical or mechanical properties of the material have met with little success. A variety of

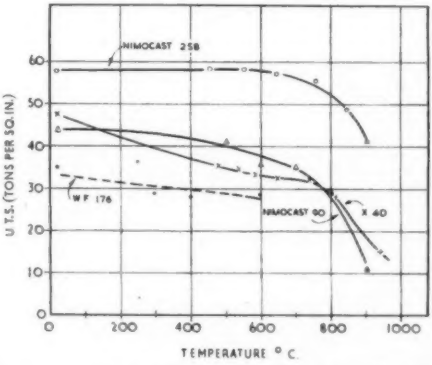


FIG. 2.—*Graph showing tensile strength* versus *temperature.*

testing procedures has been established which predict service performance in a particular design of machine, but correlation of alloy performance between one test and another, and between one machine and another, is disappointingly poor.

*Investment-cast Alloys*

Under certain conditions obtaining in gas turbines and similar machines, iron-base alloys such as HR Crown Max and cobalt-base alloys such as X40 show outstanding resistance to thermal fatigue. It is possible that the relatively large tensile ductility of these alloys, combined with slightly higher thermal conductivity compared with, say, the

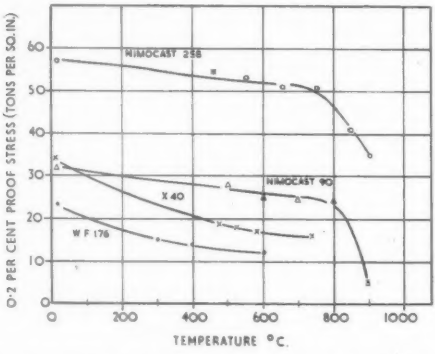


FIG. 3.—*Graph of* 0.2-*per cent. proof stress* versus *temperature.*

nickel-base materials, may be partly responsible. It should be pointed out, however, that service experience involving temperatures up to and above 1,000 deg. C. now tends to favour various nickel-base alloys such as Nimocast 242 and G.39.

## Foundry Techniques

Among the alloys listed in Table 1, those which have attracted the most favourable comment with regard to castability are probably HR Crown Max and X40, which represent respectively the iron- and cobalt-base alloy classes. Among the nickel-base alloys Nimocast 242 and G.39 are generally regarded as the easiest to handle in the foundry. At the other extreme, the more highly-alloyed nickel-base materials, when cast by the conventional methods, tend to be sluggish, possibly due to the presence of appreciable contents of titanium. Alloys of these types suggest the usefulness of inert-atmosphere melting and casting.

Recent advances in moulding techniques have been critically reviewed elsewhere[13] and will not be discussed here. Attention is directed, however, towards the evidence that melting and casting procedures have an important bearing on the properties of castings. In this connection, one of the most interesting recent developments is the use, for these alloys, of vacuum or inert-atmosphere casting. An American estimation of probable costs involved in producing investment-castings by the induction-vacuum process[14] suggests that " the time is not far off when vacuum castings will cost less than one-third more than the air-melted variety." Little practical evidence on this matter has, however, yet come to light.

*Titanium-containing Alloys*

Whilst it is reasonable to expect further development of air-cast alloys which give high mechanical properties, recent experience shows that the materials having the greatest strength at elevated temperatures are those hardened with titanium, usually in association with aluminium. Present indications are that these alloys will continue to be among the most important high-temperature materials, and that there will be a significant demand for castings. For such alloys, production by vacuum or inert-atmosphere techniques is highly desirable. Under vacuum conditions the castability of the titanium-containing alloys becomes comparable with that of titanium-free materials, in terms of fluidity and of freedom from non-metallic inclusions.

*Comparison of Air- and Vacuum-casting*

*Cobalt-base alloys:* One of the few strictly comparable records of properties of an alloy air- and vacuum-cast[15] shows that vacuum-treatment of X40 slightly increases tensile elongation at 20, 650, and 815 deg. C., the average improvements being from 8 to 13, 13 to 17, and 12 to 19 per cent., respectively.

TABLE 4.—*Oxidation Rates of Various Alloys.*

| Alloy. | Oxidation rate. Weight loss in mg. per sq. cm. after exposure for 100 hr., and descaling in sodium hydride. | | | | | | Reference. |
|---|---|---|---|---|---|---|---|
| | 750 deg. C. | 800 deg. C. | 870 deg. C. | 950 deg. C. | 1,000 deg. C. | 1,050 deg. C. | |
| G. 18B .. .. .. | 1* | 6* | 18* | 50* | — | — | 4 |
| HS. 31 (X40) .. .. .. | — | — | 9.3 | 25.2 | — | 50 | — |
| G. 34 .. .. .. .. | 2* | 2.5* | 6* | 35* | >60* | — | 3 |
| Nimocast 242 .. .. | — | — | 0.5 | 5.7 | — | — | — |
| G. 39 .. .. .. .. | — | — | — | 1* | 2* | 4* | 3 |
| Nimocast 90 .. .. .. | — | — | 1.3 | — | — | 6.6 | — |
| Nimocast 258 .. .. | — | — | 4.5 | 10.0 | — | 29.2 | — |

* 70 hr.

TABLE 5.—*Resistance of Cobalt- and Nickel-base Alloys to Corrosion by Molten Sodium Sulphate/Sodium Chloride Mixtures.*

| Alloy. | Weight loss in mg. per sq. cm. on exposure by half-immersion for 1 hr. at 900 deg. C. | |
|---|---|---|
| | $Na_2SO_4$/$\frac{1}{2}$ per cent. NaCl. | $Na_2SO_4$/25 per cent. NaCl. |
| HS.31 (X40) .. .. | 1.5 | 117 |
| Nimocast 258 .. .. | 0.6 | 48.2 |
| Nimocast 258 (Modified) | 0.6 | 0.06 |

Neither tensile strength at these temperatures, nor 100-hr. and 250-hr. rupture strengths at these temperatures, nor 100-hr. and 250-hr. rupture

strengths at 730 to 980 deg. C., was affected by the change to vacuum-casting, but average elongation at fracture was increased from 13 to 18 per cent. at 730 deg. C., from 18 to 27 per cent. at 815 deg. C., from 9 to 14 per cent. at 870 deg. C., from 10 to 13 per cent. at 925 deg. C., and from 11 to 13 per cent. at 980 deg. C. Somewhat similar results were obtained from another cobalt-base alloy, He1049.

*Nickel-base alloys:* Some new and directly comparable data for air- and vacuum-cast test-bars of two nickel-base alloys are given in Table 6. The small improvement in rupture life produced by vacuum-casting Nimocast 258 is contrasted with the rather larger improvement produced in an experimental nickel-base alloy of a similar, but more highly-alloyed, type giving improved properties. These figures support the view that vacuum-casting becomes increasingly beneficial with the increasing potential strength of the alloys, and that such methods may prove to be essential for the attainment of high-temperature properties superior to those shown by alloys of the Nimocast 258 class. Improvements in room-temperature tensile strength and ductility occur in both alloys.

*Pre-alloyed Stock*

Investment founders normally prefer to melt pre-alloyed stock, and, in theory, the advantages of vacuum-melting should be realized by remelting vacuum-treated stock material in an inert atmosphere. In practice it is likely that an atmosphere produced by flushing air from a conventional furnace by means of a stream of inert gas is insufficiently pure, and considerable scope exists for the design of a furnace which will achieve this end efficiently and economically. The alternative, which is to evacuate to a low pressure and subsequently introduce inert gas, imposes the cost penalties of vacuum-casting.

## Experience of Investment Castings made from a High-temperature Alloy

This paper is concerned mainly with test-bar properties, upon which not only alloy development, but also works control of metallurgical quality, must largely be based. It is essential, however, that designers be given every possible assistance in assessing the extent to which test-bar properties can be achieved in actual components. In this connection, Table 7 shows a series of mechanical-test results obtained from test-pieces cut from various Nimocast-90 rotors.

Whilst, with one exception, the cut test-pieces give much longer rupture-lives than the standard test-bar figures, and generally-higher elongation at fracture, considerable variation exists in the room-temperature tensile properties. From a designer's point of view, the consistency of 0.1-per cent. proof-stress values is reassuring, and the lowest tensile-elongation value recorded is likely to be adequate for most applications.

In alloys of lower mean value, however, similar scatter in elongation values is likely to be dangerous, and caution is advised in specifying stronger alloys for components of complex shape, such as turbine rotors. For such applications vacuum-casting, which produces improved mean-elongation values, may be essential in order to provide an adequate factor of safety.

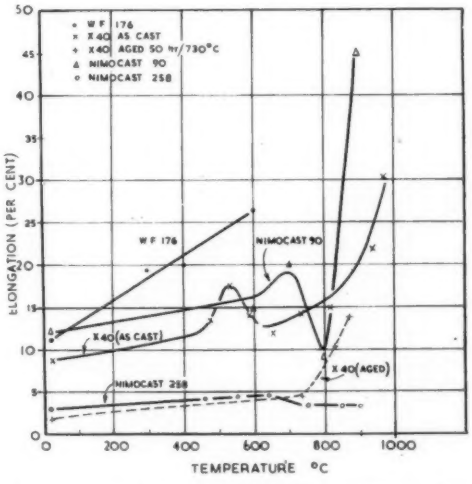


FIG. 4.—*Graph showing elongation* versus *temperature, for air-cast alloys.*

## Acknowledgments

The author acknowledges his indebtedness to The Mond Nickel Company, Limited, for permission to

TABLE 6.—*Mechanical Properties of Air- and Vacuum-cast Alloys.**

| Alloy. | Casting procedure. | Stress-rupture tests at 980 deg. C. | | | Tensile tests at 20 deg. C. | |
|---|---|---|---|---|---|---|
| | | Stress (tons per sq. in.). | Life (hr.) | Elongation at fracture (per cent). | U.T.S. (tons per sq. in.). | Elongation (per cent). |
| Nimocast 258 .. .. .. .. .. | Air | 7 | 100 | 5.5 | 55 | 3.4 |
| | Vacuum | 7 | 140 | 7.2 | 59 | 7.9 |
| Experimental nickel-base alloy .. .. | Air | 9.8 | 11 | 1.9 | 49 | 2.3 |
| | Vacuum | 9.8 | 67 | 2.0 | 54 | 4.5 |

* Laboratory test-bars were used. Each result is the mean of two or four tests.

TABLE 7.—*Room-temperature Tensile and High-temperature Stress-rupture Properties of Test-pieces cut from Nimocast-90 Investment-castings.*

| Type of casting. | Wt. (lb.) (approx.). | Locations of test-pieces. | Tensile properties at 20 deg. C. | | | Stress rupture at 13 tons per sq. in. at 750 deg. C. | |
|---|---|---|---|---|---|---|---|
| | | | 0·1 per cent. P.S. (tons per sq. in.). | U.T.S. (tons per sq. in.). | Elongation (per cent.). | Life (hr.). | Elongation at fracture (per cent.). |
| Rotor for Diesel supercharger (Foundry A)* | 1 | Heavy section parallel to axis | 33.6<br>33.8 | 42.8<br>41.0 | 13.3<br>8.9 | 698 U<br>743 U | N.D.<br>N.D. |
| Turbine rotor .. .. (Foundry B)† | 5 | Heavy section chord position | 29.2<br>— | 33.0<br>32.8 | 10.7<br>13.5 | 410<br>420<br>565<br>574<br>45.5 | 4.7<br>7.9<br>3.8<br>1.2<br>1.8 |
| Rotor for Diesel supercharger (Foundry C)‡ | 2 | Heavy section chord position | 30.8 | 40.5 | 20 | 330 | 5.5 |
| Test-bar§ .. .. .. | ¼ | | 32.5 | 45.3 | 14.1 | 100 | 1.7 |

U Unbroken.
N.D. Not determined.
* Heat-treated 4 hr. at 1,080 deg. C. (air-cooled) + 16 hr. at 720 deg. C. (air-cooled).
† Heat-treated 8 hr. at 1,080 deg. C. (air-cooled) + 16 hr. at 700 deg. C. (air-cooled).
‡ As cast.
§ Heat-treated 4 hr. at 1,080 deg. C. (air-cooled) + 16 hr. at 700 deg. C.( air-cooled).

publish this paper. He thanks D. Napier & Son, Limited, for permission to quote their hot-tensile and fatigue data on Nimocast 258, and Bristol Aero-Engines, Limited, for the hot-tensile data for Nimocast 90. The collaboration of the De Havilland Aircraft Company, Limited, in vacuum-casting Nimocast-258 fatigue-test-bars is also acknowledged.

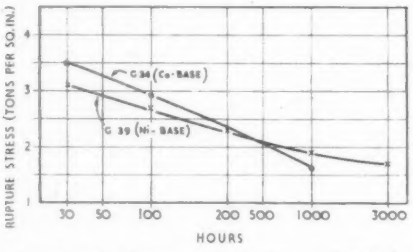


FIG. 5.—*Graph of stress* versus *time at* 1,000 *deg. C.*

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## (*Conference Sessions*)

(*Continued from page* 662)

Dust in Investment Foundries," presented by Mr. C. M. Stoch (BSCRA), who also showed a film entitled "Let's Clear the Air," describing some of the work of the BSCRA in relation to the dust problem in conventional steel foundries.

The closing session of the conference, on the Tuesday afternoon, was under the chairmanship of Mr. W. Foyers (H. & F. Precise Castings (1959), Limited) and was devoted to the presentation and discussion of two papers on investment refractories, namely: "The Use of Ethyl Silicate as a Binder for Refractory Materials," by Mr. J. I. Evans (Monsanto Chemicals, Limited); and "The Laboratory Control of Investment Refractories," by Mr. J. Mitten (D. Napier & Son, Limited). The conference closed with a short address by Mr. Armitage.

**Introducing the Author . . .**

Mr. D. R. Wood, who was born in 1925, attended the Simon Langton School in Canterbury, and graduated in Natural Sciences at Cambridge University in 1945. He spent several years in the light-alloy industry, first with the De Havilland Forge, Limited, and subsequently with the Northern Aluminium Company, Limited. Having joined the Mond Nickel Company, Limited, in 1948, Mr. Wood was for ten years engaged in alloy development and melting and casting research at the Mond Nickel Company's Birmingham laboratory. In 1958 he became responsible for his company's general development activities in connection with cast alloys for high-temperature service.

# News in Brief

THE ADDRESS of Main Metal (Great Britain), Limited, is now Bridge House, 181, Queen Victoria Street, London, E.C.4.

A £73,000 order has been placed with Guy Motors, Limited, the Wolverhampton commercial-vehicle builders, by British Road Services.

METALS & EQUIPMENT (WOLVERHAMPTON), LIMITED, have changed their address to Drayton Street, Wolverhampton. (Telephone: Wolverhampton 23581).

A FLEET of 20 new passenger carriages costing £A680,000 are to be built for the Victorian Railways country lines, in Australia. They will be constructed at the Newport workshops in Melbourne.

R. W. CRABTREE AND SONS, LIMITED, engineers, Water Lane, Leeds, have published an attractive souvenir brochure to commemorate a visit by the Queen and the Duke of Edinburgh to their works.

HORBURY'S BIGGEST WORKS OUTING took place last Saturday, when more than 1,000 employees of the mining engineering firm of Richard Sutcliffe, Limited, spent the day at Bridlington. Thirty-one coaches were used to transport the party.

LORANT & COMPANY, LIMITED, 98-100, Croydon Road, London, S.E.20, has changed its name to Newage Machine Tools, Limited, to which company future correspondence should be addressed. The constitution of the company will remain unaltered.

ORDERS worth about £250,000 for diesel-electric-locomotive gearing have been secured by the general gear division of David Brown Industries, Limited, Park Works, Huddersfield. The new locomotives are to be built at Derby for use on the Midland Region, British Railways.

TWO AUSTRALIAN METALLURGISTS, Mr. Roger Tummel and Mr. Kevin Smith, from different works of the Broken Hill Proprietary Company, Australia, are at the English Steel Corporation, Limited, Sheffield, on a four-months training course, under an exchange scheme with the Australian concern.

FOXON & ROBINSON, LIMITED, Sheffield, have made a softwood packing case for machinery which is believed to be the bulkiest ever made in Sheffield. It weighs 4½ tons and is 15 ft. 9-in. long, 10 ft. 9-in. wide, and 9 ft. 7-in. deep. It is for a 35-ton piece of machinery from the Butterley Works, Ripley, Derbyshire.

At the *V° Salon International de la Chimie*, to be held in Paris from June 16 to 30 GRIFFIN & GEORGE (SALES), LIMITED, the selling organization of the Griffin & George group of laboratory furnishers, will be exhibiting on Stand No. 2, Avenue Paul Langevin, a representative range of laboratory apparatus and equipment suitable for both industry and education.

HESS PRODUCTS, LIMITED and the chemical division of Armour Chemical Industries Limited, have been merged under the name of Armour Hess Chemicals, Limited, of which half the share capital is controlled by Armour and Company of Chicago, whilst the other half is controlled by United Kingdom interests, including a substantial proportion by Associated Chemical Companies, Limited.

AT THE FIRST Lincolnshire traction engine rally organized by the North Hykeham Memorial and Playing Fields Association and the Lincolnshire Steam Engine Preservation Society, at North Hykeham, the Lindsay Cup for engine elegance was won by Mr. J. Taylor of Sutterton, for "Dreadnought," a Fowler fairground engine. Awards in the same class were won by a Ruston Proctor traction engine, a Foster steam engine, an Aveling Porter road roller and a Sentinel undertype wagon.

STAVELEY IRON AND CHEMICAL COMPANY, LIMITED, announced on May 29 that although they were fully committed in their training scheme for junior employees they were prepared to take more on. It was said, "We feel that industry must endeavour to train as many boys as it can when they leave school. Of course, there can be no guarantee that work for them will be available at Staveley when they come out of their time, but at least they will be trained men available for opportunities whenever they arise."

ONE OF THE LARGEST ORDERS yet placed by the South African Railways for locally-manufactured goods has resulted in a £5,000,000 contract for the Union Carriage and Wagon Company, a recently-founded associate company of Leyland Motors, Limited. The contract covers 322 all-metal main-line coaches, to be constructed at the Union Carriage works at Nigel, near Johannesburg. The order, following a previous one worth £2,600,000 ensures sufficient work on railway equipment at the factory for the next three to four years.

THE SHEFFIELD BRANCH of the Purchasing Officers' Association elected the following officers at their annual general meeting on May 25:—As chairman, Mr. C. White (Batchelor's Foods, Limited); as vice-chairman, Mr. A. Townsend (Rockware Glass Syndicate); as secretary, Mr. K. A. Moore (Robert Jenkins, Limited); as treasurer, Mr. L. Hobson (Laycock Engineering, Limited); committee members, Mr. J. M. Parkes (Kayser Ellison Company, Limited); Mr. C. L. Spencer (Backer Electric Company, Limited); and Mr. D. Flanagham (Newton Chambers Company, Limited),

A GIANT 200,000 kw. turbo-alternator left the Stafford works of the English Electric Company, Limited, on May 30, for the High Marnham power station, near Retford, Notts., where it is due to arrive on Sunday, June 7. It is the heaviest electrical component ever transported in this country and together with the trailer weighs 220 tons. The transporter has an overall length of 143 ft. and, because of its size and weight, the load is travelling by a roundabout route through Sheffield and Huddersfield. It is reported to be the first machine of this rating to be built in Britain.

THOMAS BROADBENT AND SON, LIMITED, engineers, Central Ironworks, Huddersfield, have secured, in face of keen competition, a £300,000 contract for 60 centrifugal and auxiliary implements for the Taiwan Sugar Corporation of Nationalist China. Quotations were submitted by 17 leading centrifugal makers, including concerns in America, France, Germany, Sweden, Italy and Japan. It is reported that two further contracts of similar size are likely to be placed for centrifugal equipment, and Broadbents feel that, having secured the first contract they have a good chance of gaining the other two.

THE ORGANIZERS of the First International Compressed Air & Hydraulics Exhibition, which is to be held at the Empire Hall, Olympia, London, from April 25 to 29, 1960, sponsored by the journal *Compressed Air & Hydraulics*, announce that with the full co-operation of Macfarlane Watson, Limited, they have absorbed the Pneumatics & Hydraulics for Industry Exhibition and Convention which was to have been held in October, 1959, at Alexandra Palace. Consequently, the First International Compressed Air & Hydraulics Exhibition at Olympia, is now the only one which will take place.

# Raw Material Markets

## Iron and Steel

Although there was a slight improvement in the output of castings in the first quarter of the year, overall the foundries are working much below the level of a year ago. The improvement in steel demands has resulted in increased usage of castings and ingot moulds, but the biggest increase in production was obtained by the foundries catering for the motor vehicle industry. Those foundries are able to maintain good outputs of castings and their present schedules for deliveries are up to recent levels. They continue to be more favourably employed than other sections of the trade.

The foundries engaged in the production of castings for the railways are quiet, while demands from the engineering and machine-tool trades are only moderate. Fortunately for the light foundries, the improvement in the demand for castings has been maintained, and for domestic equipment use the foundries are able to obtain increased outputs, while for builders' castings a slight improvement in demand is also reported. For many foundries, however, present demands fall far short of the tonnage required to fill up productive capacity, and their plants are working at much reduced levels.

Although blast-furnace capacity remains not fully occupied, with a reduced number of furnaces in blast and others working below normal levels, the pig-iron available from current outputs together with the stocks on hand at the furnaces are more than sufficient for requirements. The steelworks are able to obtain all the basic pig-iron they require and there has recently been a slight increase in their demands. The chief demand from the foundries is for low-phosphorus irons for the production of high-duty castings, and the engineering and speciality foundries can obtain all the supplies they need at present in the several brands now available. A fairly good tonnage of hematite is also being used by them, together with some refined iron.

The better trading conditions at the light foundries has brought some increase in the call for high-phosphorus pig-iron, but not to the extent expected as those foundries continue to use increased amounts of scrap in their mixtures. Production at the furnaces is restricted and heavy stocks are held by them.

Many of the re-rollers are working at improved levels, with better demands for small bars and light sections, and there is a good demand for reinforcing rods. This has resulted in a bigger call for semi-finished steel, some of which is required to replace depleted stocks. Home steelworks can easily cope with these requirements and could provide a much greater tonnage if required.

## Non-ferrous Metals

During the next three-month control period beginning on July 1, producer members of the international tin agreement are to be allowed to increase their exports by a total of 2,000 tons. This was decided by the International Tin Council meeting in Copenhagen; it means that the permissible export quota for the third quarter of this year now stands at 25,000 tons. In more general terms, the increased quota means that the effective cut in exports will be 34 per cent., compared with 40 per cent. at present. It was also agreed between the council and the UK Government that arrangements should be made for the disposal of 2,500 tons of tin from the UK stockpile through the agency of the buffer stock manager rather than by open tender, which should minimize the effect on market prices. Finally, the council confirmed that the buffer stock manager could continue his operation in the market at prices between £780 and £830 a ton until September 30 next.

The decisions taken by the ITC appeared to have struck responsive chords in all quarters and the markets on both sides of the Atlantic have been firm. In the UK steady trading characterizes the market and the price has continued well above £780 a ton, despite unloading by the buffer stock manager. Indeed, stocks in official LME warehouses continue to fall and at the end of last week totalled only 7,664 tons. In the US steady conditions also prevail and the price is now edging up towards $1.05 a pound.

Copper is holding firm and the undertone is reported as satisfactory. The UK market is feeling the benefit of the fear of a strike in the US at the end of this month and the price is firm. US market expectations of a rise in the quotation for both custom smelters and producers have also helped to keep the UK prices steady. On the other hand, stocks in London continue to mount and at the end of last week totalled 12,898 tons, a rise of no less than 1,382 tons on the week. This unexpectedly large jump in stocks may well be due, in part, to shipments of copper to the UK for shipment to the United States should the labour strike at the end of this month materialize.

In the US the market is good and steady with prices holding firm, custom smelters quoting 32 cents and producers 31½ cents a pound. Expectations of a price increase stemmed from the rise in the price offered for scrap, which now stands at 26¾ cents, equivalent to 32½ cents refined copper for August delivery. However, no changes have as yet been made, although dealers are reported to be asking (without too much success) 33¼ cents a pound. Demand for producer metal is brisk and June metal is all but sold out.

Last week it was announced that the Board of Trade would be inviting tenders for the balance of 6,000 tons of copper for delivery from July to November this year. This is the last of the original 30,000 tons which it was announced would be sold at the end of last year.

Lead is a better market in the US than in London. In the US demand is satisfactory and the price is firm. In fact, it may well have been raised this last week except for the sluggishness of the UK market which would have widened the London-New York price beyond economic good sense. The US quotation is still 12 cents a pound.

Zinc is a reasonably satisfactory market in London, where buying of prompt metal has brought about something of a shortage, which is reflected in the widening of the backwardation. In the US the market is good but somewhat restrained owing to the possibility of a steel strike which would close one of the metal's major outlets. Nevertheless, Detroit seems to be much more on the move and special high grades are coming in for much demand. In fact, special high grades are now far from being in good supply so that a rise in the US price may well eventuate. At present the East St. Louis spot price is called 11 cents a pound.

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Mr. JOHN HALLAS, of Sheffield, was presented with the cup for the year's best graduate apprentice with the English Electric Company's Rugby Works on May 30, by Dr. F. P. Bowden, a director. He is now a mechanical engineer in the firm's steam-turbine section.

# Have you thought of designing in REFRACTORY CONCRETES?

The idea of "concrete" furnace construction may appear revolutionary, but it has already gained wide acceptance because concrete construction techniques allow the designer and builder to:

**THINK IN TERMS OF** Monolithic walls, roofs, hearths, etc., NOT brick by brick construction with its joint and other complications.

**THINK IN TERMS OF** High strengths before, during and after firing.

**THINK IN TERMS OF** Fast construction, smooth walls, easily constructed suspended roofs—all possible by concrete casting.

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AP/33

# Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

June 3, 1959

## PIG-IRON

**Foundry Iron.**—No. 3 IRON, CLASS 2, 10-ton lots or over: Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

**Low-phosphorus Iron.**—Over 0.10 to 0.40 per cent. P, 6-ton lots or over, £23 5s. 0d., delivered Birmingham, £23 10s. 0d., delivered Grangemouth.

**Cylinder and Refined Irons.**—North Zone, £25 6s. 6d.; South Zone, £25 9s. 0d.

**Refined Malleable.**—P, 0.10 per cent. max.: North Zone, £26 6s. 6d.; South Zone, £26 9s. 0d.

**Hematite.**—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent., 6-ton lots or over: N.-E. of England (local iron), £24 14s. 0d.; Scotland (Scotch iron), Zone S.1, £25 0s. 6d.; Sheffield, £26 2s. 6d.; Birmingham, £26 11s. 6d.; Wales (Welsh iron), £24 14s. 0d.

**Basic Pig-iron.**—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leicestershire, in 6-ton lots or over.

## FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

**Ferro-silicon** (6-ton lots and over).—45 per cent. Si, £41 0s. 0d. to £43 10s. 0d., scale 15s. 0d. per unit; 75 per cent. Si, £56 10s. 0d. to £60 10s. 0d., scale 15s. 0d. to 16s. 0d. per unit.

**Ferro-vanadium.**—50/60 per cent., 22s. 6d. per lb. of V.

**Ferro-molybdenum.**—65/70 per cent., carbon-free, 12s. 10d. per lb. of Mo.

**Ferro-titanium.**—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £287 0s. 0d.

**Ferro-tungsten.**—80/85 per cent., 8s. 9d. per lb. of W.

**Tungsten Metal Powder.**—98/99 per cent., 11s. 9d. per lb. of W.

**Ferro-chrome** (6-ton lots and over).—4/6 per cent. C, £77 0s. 0d. to £81 0s. 0d., basis 60 per cent. Cr, scale 26s. 0d. to 27s. 6d. per unit; over 6 per cent. C, £74 10s. 0d. to £77 10s. 0d., basis 60 per cent. Cr, scale 26s. 0d. to 27s. 6d. per unit; 2 per cent. C,* 1s. 7½d. to 1s. 10½d. per lb. Cr; 1 per cent. C,* 1s. 8d. to 1s. 11d. per lb. Cr; 0.15 per cent. C,* 1s. 9d. to 2s. 0d. per lb. Cr; 0.10 per cent. C,* 1s. 9½d. to 2s. 0½d. per lb. Cr; 0.06 per cent. C,* 1s. 9¾d. to 2s. 0¾d. per lb. Cr.

**Metallic Chromium.**—98/99 per cent., 6s. 10d. per lb.

**Metallic Manganese.**—94/96 per cent., carbon-free, £245 0s. 0d.; 96/98 per cent., £275 0s. 0d.

**Ferro-columbium.**—65/72 per cent., Cb + Ta, 19s. 9d. per lb., Cb + Ta.

**Ferro-manganese** (standard).—78 per cent., £69 10s. 0d.

## SEMI-FINISHED STEEL

**Re-rolling Billets, Blooms, and Slabs.**—BASIC: Soft u.t., 100 tons & over, £31 15s. 6d.; tested, 0.08 to 0.33 per cent. C, 6 to 35 tons, £33 15s. 6d.; hard (0.41 to 0.60 per cent. C), under 10 tons, £34 17s. 0d.; silico-manganese, under 10 tons. £43 16s. 6d.; free-cutting, under 10 tons, £36 14s. 6d. SIEMENS MARTIN ACID (under 10 tons): Up to 0.25 per cent. C, £41 1s. 0d.; silico-manganese, £44 4s. 0d.

**Billets, Blooms, and Slabs for Forging and for Stamping** (under 10 tons).—Basic, soft, up to 0.33 per cent. C, £38 10s. 0d.; basic hard, over 0.41 up to 0.60 per cent. C, £39 12s. 6d.; acid, up to 0.25 per cent. C, £43 4s. 0d.

## FINISHED STEEL

**Heavy Plates and Sections** (under 10 tons).—Ship plates (N.-E. Coast), £42 2s. 0d.; boiler plates (N.-E. Coast), £44 12s. 0d.; floor plates (N.-E. Coast), £43 11s. 0d.; angles (N.-E. Coast), £39 16s. 6d.; joists (N.-E. Coast), £39 12s. 6d.

**Small Bars, Sheets, etc.**—Rounds and squares, under 3 in., and flats 5 in. wide and under, untested soft basic, 50 tons and over, £39 1s. 0d.; under 10 tons to 4 tons, £40 18s. 0d.; under 4 tons to 2 tons, £41 3s. 0d.; hoop and strip, coils, 100 tons & over, £38 0s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., 25 tons to under 50 tons, £43 16s. 0d.; black sheets (hand mill), 24g., 10 tons & over, £57 14s. 6d.; galvanized corrugated sheets, 24g., 10 tons & over, £66 10s. 0d.

**Alloy Steel Bars.**—1 in. dia. and up: Nickel, £68 10s. 0d.; nickel-chrome, £99 4s. 0d.; nickel-chrome-molybdenum, £111 17s. 0d., in lots of 5 tons to under 10 tons.

## NON-FERROUS METALS

**Copper.**—Cash, £239 0s. 0d. to £239 5s. 0d.; three months, £238 0s. 0d. to £238 15s. 0d.; settlement, £239 5s. 0d.

**Copper Tubes, etc.**—Solid-drawn tubes, 2s. 4d. per lb.; rods, 254s. 6d. per cwt. basis; 20 s.w.g., 289s. 6d. per cwt.

**Tin.**—Cash, £787 0s. 0d. to £787 10s. 0d.; three months, £788 0s. 0d. to £788 10s. 0d.; settlement, £787 10s. 0d.

**Lead (Refined Pig).**—First half June, £70 0s. 0d. to £70 5s. 0d.; first half September, £71 5s. 0d. to £71 10s. 0d.

**Zinc.**—First half June, £77 10s. 0d. to £77 15s. 0d.; first half September, £76 10s. 0d. to £76 15s. 0d.

**Zinc Sheets, etc.**—Sheets, 15g. and thicker, all English destinations, £113 5s. 0d.; rolled zinc (boiler plates), all English destinations, £101 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £94 0s. 0d.

**Brass Tubes, etc.**—Solid-drawn tubes, 1s. 10⅞d. per lb.; sheets to 10 w.g., 203s. 6d. per cwt.; wire, 2s. 8¼d.; rolled metal, 203s. 6d. per cwt.

**Brass (Brazing).**—BS1400, B3 (65/35), £158; B6 (85/15), £215.

**Brass (High Tensile).**—BS1400, HTB1 (30 tons), £190; HTB2 (38 tons), £208; HTB3 (48 tons), £220.

**Gunmetal.**—BS1400, LG2 (85/5/5/5), £196; LG3 (86/7/5/2), £206; G1 (88/10/2/½), £266; (88/10/2/1), £247.

**Phosphor Bronze.**—BS1400, PB1 (AID released), £290 per ton.

**Leaded Phosphor Bronze.**—BS1400, LPB1 (1060), £218 per ton.

**Phosphor Bronze Strip, etc.**—Strip, 296s. 3d. per cwt.; wire, 4s. 1½d. per lb.; rods, 3s. 4½d.; tubes, 3s. 4½d.; chill cast bars: solids 3s. 4d.; cored 3s. 5d. (CHARLES CLIFFORD, LIMITED.)

**Nickel Silver, etc.**—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 9¾d. per lb.; round wire, 10g. in coils (10 per cent.), 4s. 2¾d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 4s. 1¾d. All prices are net.

**Other Metals.**—Magnesium, ingots, 2s. 3d. per lb. Antimony, English, 99 per cent., £190 0s. 0d. Quicksilver, ex-warehouse, £77 10s. 0d. Nickel, £600 0s. 0d. Aluminium, ingots, £180 0s. 0d.; aluminium bronze (BS1400), AB1, £234; AB2, £248.

* Average 68-70 per cent.

## Staffordshire Engineering Firms to Amalgamate

Proposals have been agreed between Bullers, Limited, electrical engineers and ironfounders, of Tipton (Staffs), and Taylor Tunnicliff (Electrical Industries), Limited, Hanley (Staffs), for the amalgamation of the two companies under a new holding company, Allied Insulators, Limited. The new company will acquire the issued share capitals of Bullers and the three operating subsidiaries of the Taylor Tunnicliff group.

Preference holders of Taylor Tunnicliff will receive 12 6 per cent. cumulative preference shares of £1 in Allied for every 11 shares held, and ordinary holders one 5s. ordinary in Allied and 5s. 10d. cash for every ordinary held. Helbert Wagg & Company, Limited, on behalf of Allied, is offering to acquire Bullers' preference on a one-for-one basis, and the ordinary at the rate of 120 5s. ordinary and 13 £1 preference in Allied for every 50 10s. units held. Helbert Wagg will purchase at not less than 17s. per share any preference in Allied which ordinary holders wish to sell.

It is estimated that, in the absence of unforeseen circumstances profits of the new group for 1959 will be in the region of £500,000. This is lower than the total profits of the two companies for 1958.

The following directors have been appointed to the board of Allied Insulators:—Chairman, Mr. P. Cooper (chairman of Taylor Tunnicliff); vice-chairman, Mr. G. H. Harris (chairman of Bullers); Mr. F. W. Chambers, Mr. J. E. Harris, and Mr. J. Turner (Bullers); Mr. J. V. Cooper, Mr. L. H. Jones, Mr. J. F. Moxon, and Mr. T. G. D. Scrivener (Taylor Tunnicliff).

## US Parent bid for British Timken

Expectations that the bid for the 2,337,500 outstanding shares of British Timken, Limited, by the Timken Roller Bearing Company, the US parent firm, would not reach the 90 per cent. target, were borne out last week when it was announced that the offer had been accepted by over 83 per cent. of the holders of the minority shares, representing over 1,600,000 ordinary shares.

As a result the US company now owns over 85 per cent. of the capital. The offer has been made unconditional and extended to June 9 to allow other holders to accept.

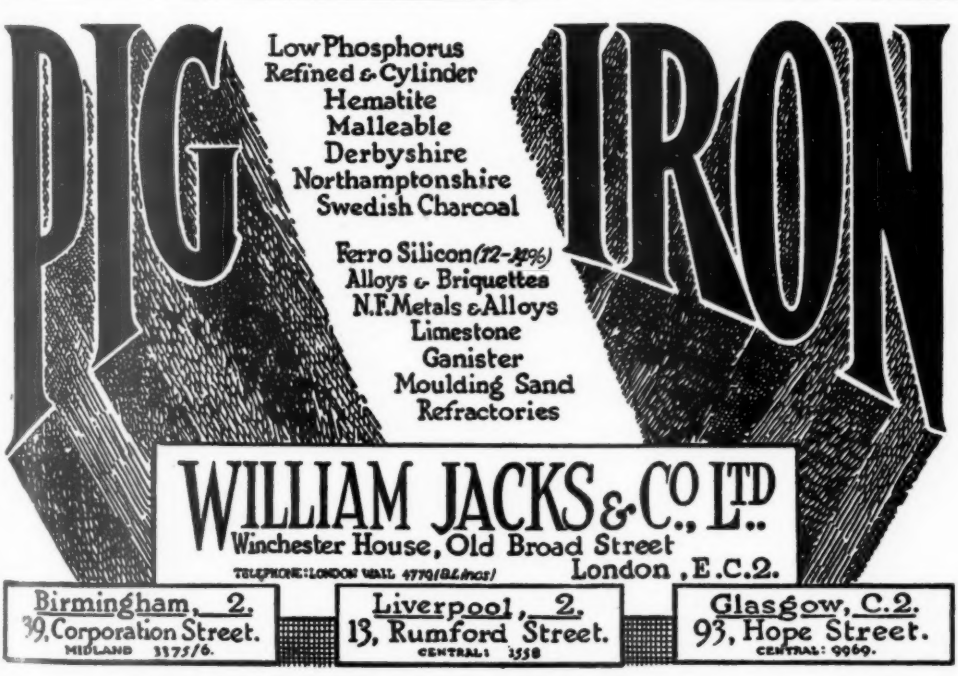
Sir John Pascoe, chairman and managing director of British Timken, said any comments he wished to make would be reserved for the annual meeting (held last Friday). It is believed that the institutions among the shareholders preferred to retain their shares as the price of 83s. 9d. was not attractive enough for the long-term investor.

## *Board Changes*

ENGLISH CHINA CLAYS, LIMITED—Mr. F. H. Simon has been appointed a director.

BOULTON & PAUL, LIMITED—Mr. F. Russell and Mr. L. A. Trafford have been appointed directors.

METAL CLOSURES, LIMITED—Mr. Stanley E. Clotworthy has been appointed a director. He is managing director of the Northern Aluminium Company, Limited.



# Company News

WILLIAM SUGG & COMPANY, LIMITED, engineers and non-ferrous founders, of London, S.W.1—An interim dividend of 5 per cent. is announced. There was a single payment of 10 per cent. for the previous year.

H. & C. DAVIS & COMPANY, LIMITED, light structural engineers, etc., of London, S.W.4—The company, which is controlled by Henry Briggs Son & Company (Trust), Limited, has declared a second interim dividend of 7½ per cent. in respect of the 18 months ending June 30, 1959, payable August 12.

HATTERSLEY (ORMSKIRK), LIMITED, engineers and non-ferrous founders, of Ormskirk (Lancs)—The dividend is being raised from the equivalent of 16¼ per cent. to 17½ per cent. for the year to March 31, 1959, with a final of 13¾ per cent. Group net profit is £289,740 (£252,420), after a tax of £296,201 (£304,491).

SIEBE, GORMAN & COMPANY, LIMITED, manufacturers of breathing apparatus, safety and protective devices, etc., of Chessington (Surrey)—With an unchanged dividend of 12 per cent. the company announces an increased bonus of 8 per cent., against 5 per cent. for 1958. Net profits advanced from £98,212 to £111,842, after tax of £104,735 (£106,824).

BRITISH ROPES, LIMITED—Philip Hill, Higginson & Company, Limited, announces that in response to the offer by British Ropes to its stockholders of 6,682,277 ordinary 2s. 6d. shares at 7s. 6d. each, applications have been received for 6,417,319 shares. In accordance with the terms of the issue, rights to the shares not accepted have been sold and the net proceeds will be remitted to those persons to whom the relative provisional allotment letters were originally issued.

G. D. PETERS & COMPANY, LIMITED, manufacturers of road and railway rolling stock equipment, etc., of Slough (Bucks)—The chairman, Mr. Alexander Dowie, referred at the company's annual meeting on May 25, to his statement with the accounts that the production of vacuum brake cylinders came to a standstill at the end of last year. The British Transport Commission had, he said, given the company authority to continue the production of brake cylinders "at a trickle" until such time as the commission made a decision about the continuity of the wagon braking programme. Mr. Dowie said that production was far below capacity and provided little profit compared with the profits which should have accrued from this source. A serious diminution in the profit for 1959 must be anticipated, he said.

## Unemployment Now Under 500,000

Unemployment fell by 50,000 between April 13 and May 11 and, for the first time since last September, the total of registered unemployed is below 500,000. The figure on May 11 was 481,000, or 2.2 per cent. of the working population. This compares with 2.2 per cent. a month previous and 2.1 per cent. a year ago.

The drop of 50,000 is almost entirely accounted for by a decline of 42,000 in the wholly unemployed. The number of unfilled vacancies on May 6 was 210,000, 12,000 more than in April.

Only the northern, north-western, Scottish, and Welsh regions now have percentages above the national figure. Scotland is 4.5 and Wales 4 per cent. Lowest percentage—1.31—is recorded for London and south-eastern region. Northern Ireland's incidence of unemployment still remains high, having increased by 403 to give a percentage of 8.0.

# New Patents

*(Copies of complete specifications are obtainable from the Patent Office, Sales Branch, 25, Southampton Buildings, Chancery Lane, London, W.C.2, price 3s.)*

**807,531.** Patentverwertungsgesellschaft für Eisen und Metalle m.B.H. Salzkotten, Westphalia, Germany.

A process for the production of castings, particularly from melts of iron and iron-alloys including steels, but applicable also to non-ferrous metals such as aluminium, containing impurities in the form of oxide slag inclusions capable of being reduced by hydrogen, by a gas-treatment of the melt. Hydrogen is introduced either in the gaseous state or as hydride (such as calcium hydride or magnesium hydride). Claims are also made in this invention for the hydride particles to be coated with paraffin, plastics, or enclosed in sheet-iron capsules.

**807,633.** W. C. Cheney, 404 South Oak Street, Lake City, Minnesota, USA.

Cast light-metal pistons for internal-combustion-engines of the fuel-injection type. These have a ferrous-metal insert in the head portion to receive the high-velocity jet of fuel injected.

**807,673.** George Blair & Company, Limited, Almond Carr Works, Tow Law, Durham.

In the casting of articles in iron and steel it is proposed to have one or more holes in each mould perpendicular to the moulding surface normal to the direction in which the moulding article is to be ejected. Push rods are employed, adapted to enter and partially occupy these holes so that when the molten metal is poured it flows into these holes until it comes up against the ends of the push rods. On cooling, pips are formed on the surface of the moulded article, the casting being forcibly ejected from the mould on cooling by pressure exerted by the push rods on the pips. These pips can be removed from the castings after the latter have cooled.

**807,775.** National Lead Company, 111 Broadway, New York, N.Y., USA.

Cold chamber die-casting apparatus. This invention refers particularly to improvements in the charging apparatus for a cold-chamber shot-sleeve.

## Butterley Company's Losses

Exceptional losses of £758,383 (£153,729) in connection with certain activities are reported by the Butterley Company, Limited, bridge builders, constructional engineers, ironfounders, etc., of Derby. The total includes a charge of £713,076 in respect of the completion of contracts for tonnage oxygen plants which, in the opinion of the directors, covers the commitments of the company in respect of these contracts, the responsibility for completion of which has been assumed by an associated company.

Further provisions in respect of the contracts will have to be made by the Butterley Company only if the associated company incurs losses on them which are not covered by current profits.

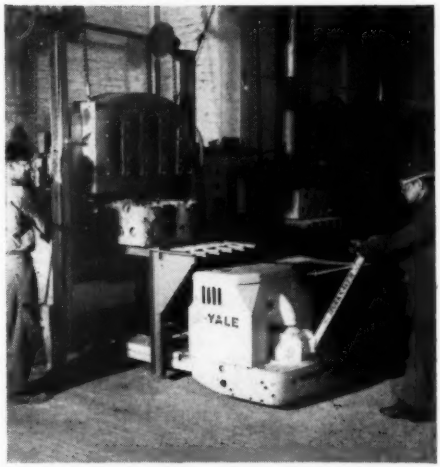
Crediting tax recoverable of £134,406 (£35,523 charged), a group net loss of £549,390 is reported against a previous profit of £14,331. The loss attributable to the holding company is £470,461 (profit £57,162).

No further capital profits distribution for 1958 is recommended, but the position will be reviewed in October. Last December the capital distribution was 4d. per 2s. 6d. ordinary share in lieu of an interim dividend. In 1957 such distribution totalled 1s. per share. The distribution takes £30,000 (£90,000).

# COST CUTTING IN FOUNDRIES

## Yale trucks save time, reduce accident risks

Many famous British foundries now use Yale industrial trucks and hoists to reduce operation times, to increase safety and lessen fatigue, to reduce costs. For years Yale & Towne has helped solve many problems of handling molten metal, castings and other materials. This experience is at the service of any foundry. That is the purpose of the Yale Advisory Service.




### *Saving time . . .*

Catton and Company Limited of Leeds designed a furnace charger consisting of a steel frame counterweighted at the rear and with prongs at the front, with sufficient underclearance to allow it to be lifted by a Yale platform Worksaver. The brick floor of the furnace was recessed to take the charger prongs. The Worksaver delivers the castings right into the furnace. Lowering the truck's platform leaves the castings resting securely on the fire brick. Truck and charger are then withdrawn. Hot castings are removed by a reversal of this procedure.

Before this method was devised, charging was accomplished manually, taking 1½ hours, during which time the furnace temperature fell to 300°C. The complete heat treatment cycle took 14 hours. Now, clearing and charging take only 5 minutes; the temperature falls to 600°C.; the heat treatment cycle is only 6½ hours. The savings in power consumption and furnace time have increased Catton's productivity — *and* lessened manual fatigue.

**Yale Worksavers are available in Platform or Pallet models (2 or 3 tons): Fork Lift (1,500, 2,000, 2,500, 3,000 lbs.). Tractor (700 lbs. draw bar pull).**

### *Reducing accidents . . .*

The Hill Top Foundry, in Staffordshire, uses Yale electric platform Warehouser trucks to transport molten metal between furnaces and moulding bays. The metal is tapped from the furnace into a rotatable ladle fixed to a specially designed stillage — a load of some two tons.

A major factor in determining the choice of this Yale truck was the high degree of stability required both during transport and pouring.

**Yale Warehousers are available in Platform models (2 tons); Fork Lift models (2,000 and 3,000 lbs.).**

The Yale range includes power trucks for every load up to 200,000 lbs.: Hand Trucks for loads up to 12,000 lbs.: Hoists for lifting up to 40 tons (trolleys for all models); Pul-Lifts (from ¾ to 15 tons).

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## Personal

Mr. C. E. WRANGHAM has been appointed joint managing director of the Power-Gas Corporation, Limited.

Mr. FRED KERSHAW, foreman in the moulding department of Bentley & Jackson, Limited, papermakers' engineers, of Bury (Lancs), has retired after 50 years' service with the firm.

Mr. L. E. GARDNER, chief chemist to the Imperial Steel Works of Edgar Allen & Company, Limited, Sheffield, is on a six-months' visit to the cement plant at Doroud, Iran, the equipment for which was largely supplied by the company.

Mr. J. BUSFIELD has been appointed a director of Crofts Engineers (Holdings), Limited, Crofts (Engineers), Limited, and J. Parkinson and Son (Shipley), Limited. Mr. MAURICE T. J. GOFF has been appointed a director of the latter company.

Mr. F. V. VAISSIERE, who has been elected a director of Henley's Foundries, Limited, ironfounders, Cradley Heath, Staffs, in succession to Mr. F. W. M. ANDERSON, is assistant general manager of the parent company, W. T. Henley's Telegraph Company, Limited.

Mr. G. S. PARISH has been appointed sales manager, London area (including Home and Eastern counties) of the David Brown Corporation (Sales), Limited, and will operate from the London office of the David Brown Group, 96/97 Piccadilly, London, W.1.

Mr. S. WALKER, vice-chairman of Laycock Engineering, Limited, Sheffield, is now in the United States, having travelled on the Queen Mary. Mr. Walker resigned the managing directorship of the company last year at the age of 65, and his main work is now as a director of the parent company, Birfield, Limited.

Mr. W. K. MOORE has been appointed manager of the newly-formed gas-cleaning division of Steels Engineering Installations, Limited, Sunderland. For two years he was assistant manager at the Newcastle branch of Air Control Installations, Limited, and previously was with Sturtevant Engineering Company, Limited.

Mr. L. G. T. FARMER, joint managing director of the Rover Company, Limited, has been elected president of the Birmingham Chamber of Commerce in succession to Mr. NORMAN LANCASTER. Mr. PETER MIDDLEMAS, a director of the Birmingham Railway Carriage and Wagon Company, Limited, has been elected senior vice-president.

Mr. R. G. C. STEPHENSON, managing director, Indian Oxygen & Acetylene Company, Limited, has been appointed managing director, Commonwealth Industrial Gases, Limited (Australia), from June 1. Both companies are subsidiaries of the British Oxygen Company, Limited. Mr. R. C. BOOTH, finance director and secretary, Commonwealth Industrial Gases, has been appointed assistant managing director.

Mr. ALASTAIR MACLEOD has been appointed a member of the Eastern Area Board of the British Transport Commission. Mr. MacLeod is a director of Dorman Long & Company, Limited, the Steetley Company, Limited, and the North Yorkshire Shipping Company and chairman of the United Kingdom Ferro-Manganese Company, Limited. He will fill a vacancy caused by the retirement for health reasons of Sir EDMUND BACON.

To commemorate 25 years' service with the company he joined in 1933 as a 15-year-old office boy, Mr. FRANK VINCENT, a director of Cox & Danks, Limited, Oldbury, was on May 27 presented with a gift from his fellow directors. The presentation was made by Mr. John Black, deputy chairman of Metal Industries, Limited, the parent company of Cox & Danks. The teak from which the gift—a set of garden furniture—was made, was taken from a warship broken up by one of the companies in the British Industries group.

The 1959 John Morris Memorial Award, made by the British Industrial Truck Association, has been won by Mr. GEORGE DOWNIE, an executive officer, materials handling, of Unilever, Limited, who received the award for his paper entitled "How Greater Use of Industrial Trucks Can Benefit the British Economy." The award is in the form of a scholarship valued at approximately £550, and this year provides a course of intensive study at the Sixth Annual Materials Handling Training Centre at Lake Placid, New York, USA, from June 14 to 27.

Mr. W. R. D. BROWN, chairman and managing director of the Glacier Metal Company, Limited, has proposed a separation of these posts which he has held for the past 20 years. He states that with the growth in size of the company, it is becoming essential that the chairman has more time available to attend to the wider aspects of the company's affairs. Accordingly he has relinquished the position of managing director but continues as chairman. Mr. F. B. MCPHERSON, a director and general manager of the company's Kilmarnock factory, and deputy managing director, has been appointed managing director of the company.

## Obituary

### WILLIAM WILLIAMS

Mr. William Williams, chairman of William Williams & Sons (Holdings), Limited, and of Sklenar Furnaces, Limited, Cardiff, died on May 27 in his 76th year. Mr. Williams, who was born in Cardiff, became an apprentice to the foundry industry at the age of 11, emerging at the age of 20 as a journeyman moulder. When he was 22 he decided to set up in business on his own, and his main output in those days was railway-wagon bearings. By 1926 he had established a flourishing non-ferrous foundry whose patented solid unit pickling cradles have gained world-wide reputation.

In 1932, the Williams Alexandra Foundry moved to its present site in East Moors Road, Cardiff, since when it has continued to flourish under Mr. Williams' chairmanship, and from which have been founded several subsidiary companies. These were recently re-formed as William Williams & Sons (Holdings), Limited, and include Williams Alexandra Foundry, Dialoy, Limited, Bronze Smelters, Limited, and H. Cook (Engineers), Limited. Mr. Williams had been chairman of Sklenar Furnaces, Limited, since the formation of the company. He was always a strong supporter of foundry associations, and in 1932 was branch-president of the South Wales branch of the Institute of British Foundrymen. He was also a member of the South Wales Institute of Engineers and of the Institute of Metals.

Mr. WILLIAM PATON, who died on May 28 at the age of 91, was formerly foreman patternmaker with Low & Duff, Limited, engineers, brassfounders, etc., Monifieth, with whom he served for over 56 years.

The death has occurred of Mr. ALFRED JOHNSON, chairman of C. H. Johnson Machinery, Limited, and Johnson & Hartley, Limited, Stockport. Aged 90, Mr. Johnson was actively engaged in the business up to his death.

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# Book Reviews

**A Diderot Pictorial Encyclopædia of Trades and Industry.** Edited by C. C. Gillespie and published in two volumes by G. Dover Publications, Inc., 180, Varick Street, New York, 14, USA; price $18.50.

Anyone who has undertaken research work into the early history of industry is bound to have come across the name of Diderot. For 20 years he worked assiduously to describe and illustrate the trades of his times—these being about the second quarter of the 18th century. The publishers of these beautifully-produced volumes have taken the most interesting of Diderot's plates and impeccably republished them with all-too-short annotations. No fewer than 485 plates have been used and these cover a multitude of trades, ranging from bookkeeping to blast furnaces.

The section dealing with various aspects of foundry practice is alike extensive and informative. The French *patron* was very conservative and was tardy in following the English lead in using coke instead of charcoal for fuel. Perhaps he thought his forests were inexhaustible and with some sense of "good housekeeping" thought the sulphur fumes from coke were bad for his workpeople. Again, he might have suspected that deterioration in the quality of his products would follow from the use of coke. Diderot's period was characterized by the use of the blast furnace for making castings direct from its products or the casting of pig-iron to be subsequently remelted. Moreover, the same furnaces would make metal for the production of wrought iron. Other branches of foundrywork are shown in these volumes by plates covering art statuary, bell and gun founding. The reviewer has nothing but praise for the republication, with English explanations, of this great classic, which should be acquired by all who are interested in the beginnings of the industrial revolution. The most advanced technique of the time—from a manufacturing point of view—was undoubtedly that employed in the paper and printing industry.

V. C. FAULKNER.

**Manufacture of Iron and Steel, Vol. II.** Second-revised edition by G. R. Bashforth, F.I.M.; published by Chapman and Hall, Limited, 37, Essex Street, London, W.C.2; price 41s. 6d., post free.

This is a down-to-earth account of steelmaking which was first published in 1951 and now appears in a second edition minus the fuels and refractories sections. It finishes with the steel ingot and does not include mechanical working, but eight pages are devoted to continuous casting. It is a pity that the preparation of this edition was presumably a little too early to include vacuum-casting procedures which now appear to be so important in steelmaking.

Apart from this, the processes using oxygen enrichment for refining are dealt with quite fully. The deleterious effect of hydrogen in steel is emphasized and Bessemer converters using the oxygen/steam blast are said to show a hydrogen flame at the beginning of the blow. The student might well enquire whether this hydrogen from the decomposed steam has adverse effects on the steel, for on p. 222 it is stated that the hydrogen absorbed increases with that available in a furnace chamber. On p. 281 the liability of hydrogen hairline-crack formation is discussed in relation to various processes, but the Bessemer is not included amongst them. Chapter 5 describes side-blown converters and states that they are employed for steel castings, but the latter subject ends there and is not indexed.

The physical chemistry of steelmaking is reviewed and a good account is given of ingots. No mention appears to have been made, however, of "ingot-corner segregation" which can produce trouble. Scrap selection is not dealt with but the effect of residual metals is briefly mentioned. The inclusion of typical furnace logs and heat balances is to be commended.

Such a useful book justifies a much fuller index than is provided. For instance, "rimming steel" is listed but neither "non-ageing steel" nor "strain ageing" appear in the index—though the latter effect is described on pp. 72 and 73. Some misprints such as Jeavons (p. 71), Brinnell (p. 270) and a nitrogen content of 0.075 in Bessemer steel (p. 103) should be corrected in the next edition.

HUGH O'NEILL.

# House Organs

**Demag News, No. 152/1958.** Issued by Demag A. G., Duisburg, Germany.

The main article in this well-produced magazine is a ten-year review of developments and progress in the construction of rotary compressors made by the Demag concern. Like the British Iron and Steel Federation, the company has produced a model of an integrated steelworks for exhibition purposes, and this also is described and illustrated. The most interesting article, from a foundry point of view, is one giving details of a bronze which is resistant to chemicals, and is based on copper/silicon/aluminium (DKS 35/92). Applications rather than manufacturing details are stressed.

**Zinc No. 6,** English edition, issued by the Zinc Development Association, 34, Berkeley Square, London, W.1.

This issue has been prepared by the *Commission Technique des Alliages de Zinc,* but, as usual, it covers the production of this metal in this country, France, Germany, Holland and Italy. The theme of the *Bulletin* is "Zinc Die-castings in the Television and Sound-reproducing Industries." It opens with the important statement that in 1958 over 90,000 tons of zinc-alloy castings were made in Western Europe. The booklet carries about 30 illustrations and well shows the versatility of the die-casting process.

**Ruston Review and Paxman News. No. 3, 1959.** Issued by Ruston & Hornsby, Limited, Lincoln.

This firm issues a number of house organs, but the present one is designed to interest the company's overseas agents and customers, and this is accomplished particularly well. The reviewer especially liked the "News in Brief" section, as nothing could better illustrate the world-wide activities of this great engineering works.

**Alloys and Metals Review. No. 1.** Issued by Union Carbide, Limited, 103, Mount Street, London, W.1.

This very interesting new magazine is mainly devoted to foundry activities, though space is spared for the steel industry. A new refractory material—silicon nitride—is described and some of its uses illustrated. Also contained in the booklet, is a story as to the use of silicon briquettes especially in cupola practice for controlling the carbon and silicon content of the metal within narrow limits.

**Tin and Its Uses, No. 46, 1959.** Issued by the Tin Research Institute, Fraser Road, Greenford, Middlesex.

To commemorate the centenary of the hanging of "Big Ben," the great bell in the Clock Tower of the Houses of Parliament, this issue carries an illustrated account of its casting at the Whitechapel Foundry on April 10, 1858.

## New Catalogues

**Centrifugally-cast Steel Components.** T.283 is the number given to an eight-page booklet issued by Lloyds (Burton), Limited, Burton-on-Trent, covering castings made in Thermalloy—a range of alloys developed by Lloyds in association with the American Brake Shoe Company. This connection is adversely reflected when in detailing, on page 5, the physical properties of four alloys, the tensile figures are given in pounds per sq. in. instead of tons per sq. in. The arithmetic necessary to work out just what these figures mean to the average British reader should have been done before publication. Courtesy towards readers has been shown in other tables by giving the Centrigrade figures as well as Fahrenheit. Otherwise the booklet deals very interestingly with an interesting subject.

**Steel Castings.** A 28-page, well-illustrated booklet has been received from the North British Steel Foundry, Limited, Bathgate, Scotland, which is devoted to the steelfoundry service this concern accords to its customers. The control methods are well set out, but the wisdom of showing a radiograph of a defective cast-steel fly-wheel section is queried. Together with a second one—of a sound casting—it could have stressed the benefits to be obtained from meticulous inspection. The help that can be given to designers is rightly emphasised. The properties of 31 steels are set out in an 11-page section, which in itself is a useful help to designers. The tartan embellishments used throughout the brochure give a distinctive appearance to an altogether acceptable example of business literature.

**Electric Heat-treatment Furnaces.** In brochure RF. 1/59, Royce Electric Furnaces, Limited, Sir Richard's Bridge, Walton-on-Thames, Surrey, illustrate and describe two standard ranges—known as types RBH and RBM—of box-type electric furnaces. The former has a temperature range of up to 1,000, and the latter 1,250 deg. C. The brochure carries tables showing the dimensions of the four models in each range, and their shipping specifications.

**Nitrogen Generators.** Birlec, Limited, Erdington, Birmingham 24, in publication No. 705, describe and illustrate a newly-developed range of nitrogen generators—a gas which is used in many industries, including that of metallurgy. The brochure is devoted to the use of the gas for creating suitable atmospheres in furnaces.

**Permanent Magnetic Pulleys.** Publication No. 121/R issued by Rapid Magnetic Machines, Limited, of Lombard Street, Birmingham, carries a wealth of dimensional data for the Rapid permanent pulley and the C.P.P.-type separators. The pulleys are made from Alcomax alloy and so require no electrical wiring or switchgear.

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### Birlec Dryers for Italian Atom Station

An order has recently been placed with the dryer and gas plant division of Birlec, Limited, for two dryers to be supplied for the Italian nuclear power-station under erection at Latina. To be installed in the main reactor cooling circuits, the dryers will remove water vapour from the carbon dioxide gas used in the heat transfer system.

This order brings to a total of 18 the number of carbon dioxide dryers being supplied by Birlec for home and oversea nuclear power stations. The total value exceeds £100,000.

*Lost wax casting originated with the Chinese many years B.C*

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# Pig-iron and Steel Production

## *Statistical Summary of March Returns*

**The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table 1 summarizes activities during recent months. Table 2 gives production of steel ingots and castings in March. Table 3, weekly average production of finished steel in February. Table 4 gives the production of pig-iron and ferro-alloys in March, and furnaces in blast. (All figures are weekly averages in thousands of tons.)**

TABLE 1.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production.*

| Period. | B.o.T. Price Index, 1938 = 100. | | | Iron-ore output. | Imported ore used. | Coke sent to blast-furnaces. | Pig-iron ferro-alloys prod. | Scrap used in steel prod. | Steel (incl. alloy). | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Iron and steel. | Coal. | Basic materials excl. fuel[1] | | | | | | Imports.[2] | Prod. ingots, castings. | Delivrs. finished steel. | Stocks.[3] |
| 1957 .. .. | 328 | 488 | 537 | 325 | 303 | 270 | 275 | 220 | 14 | 417 | 322 | 1,444 |
| 1958 .. .. | 343 | 503 | 478 | 276 | 262 | 227 | 245 | 196 | 9 | 369 | 284 | 1,542 |
| 1958—Nov. .. | 341 | 509 | 476 | 289 | 237 | 210 | 234 | 187 | 5 | 352 | 281 | 1,563 |
| Dec.[4] | 341 | 509 | 473 | 269 | 230 | 206 | 223 | 166 | 4 | 314 | 239 | 1,547 |
| 1959—Jan. .. | 342 | 508 | 474 | 273 | 236 | 203 | 229 | 189 | 4 | 357 | 266 | 1,562 |
| Feb. .. | 342 | 506 | 471 | 277 | 214 | 199 | 222 | 190 | 5 | 347 | 276 | 1,485 |
| Mar.[4] | 342 | 506 | 471 | 276 | 217 | 195 | 221 | 195 | 4 | 363 | — | 1,471 |

TABLE 2.—*Average Weekly Production of Steel Ingots and Castings in March*, 1959.

| District. | Open-hearth. | | Bessemer. | Electric. | All other. | Total. | | Total ingots and castings. |
|---|---|---|---|---|---|---|---|---|
| | Acid. | Basic. | | | | Ingots. | Castings. | |
| Derbys, Leics, Notts, Northants, and Essex .. | — | 3.5 | 13.7 (basic) | 1.8 | 0.1 | 17.9 | 1.2 | 19.1 |
| Lancs (excl. N.W. Coast), Denbigh, Flints, and Ches .. .. .. .. .. | 0.7 | 34.8 | — | 2.4 | 0.2 | 37.0 | 1.1 | 38.1 |
| Yorks (excl. N.E. Coast and Sheffield) .. .. | | | | | | | | |
| Lincs .. .. .. .. .. .. | — | 45.8 | — | — | 0.1 | 45.8 | 0.1 | 45.9 |
| North-East Coast .. .. .. .. .. | 0.4 | 60.0 | — | 1.1 | 0.3 | 60.4 | 1.4 | 61.8 |
| Scotland .. .. .. .. .. .. | 1.3 | 29.8 | — | 2.3 | — | 31.7 | 1.7 | 33.4 |
| Staffs, Shrops, Worcs, and Warwicks .. .. | — | 15.3 | — | 3.6 | 0.8 | 18.0 | 1.7 | 19.7 |
| S. Wales and Monmouthshire .. .. .. | 1.5 | 81.4 | 7.2 (basic) | 0.8 | 0.1 | 90.6 | 0.4 | 91.0 |
| Sheffield (incl. small quantity in Manchester) .. | 7.4 | 32.0 | — | 10.2 | 0.3 | 48.3 | 1.6 | 49.9 |
| North-West Coast .. .. .. .. .. | 0.1 | 0.7 | 2.7 (acid) | 0.3 | — | 3.7 | 0.1 | 3.8 |
| Total .. .. .. .. .. .. | 11.4 | 303.3 | 23.6 | 22.5 | 1.9 | 353.4 | 9.3 | 362.7[4] |
| February, 1959 .. .. .. .. .. | 11.9 | 288.3 | 22.2 | 23.0 | 2.0 | 337.7 | 9.7 | 347.4 |
| March, 1958 .. .. .. .. .. | 17.9 | 364.6 | 21.3 | 25.6 | 2.9 | 419.9 | 12.4 | 432.3 |

TABLE 3.—*Deliveries of Non-alloy and Alloy Finished Steel.*

| Product. | 1957. | 1958. | 1958. | 1959. | |
|---|---|---|---|---|---|
| | | | Feb. | Jan. | Feb. |
| *Non-alloy steel:* | | | | | |
| Ingots, blooms, billets and slabs[5] | 5.0 | 4.6 | 4.6 | 5.2 | 4.3 |
| Heavy rails .. | 11.2 | 10.2 | 10.9 | 6.6 | 8.2 |
| Sleepers .. .. | 1.3 | 1.2 | 1.6 | 0.6 | 1.0 |
| Fishplates and soleplates .. .. | 0.8 | 0.7 | 0.9 | 0.5 | 0.5 |
| Plates: | | | | | |
| (i) ⅜ in. thick and over .. | 34.0 | 29.6 | 34.9 | 25.3 | 27.4 |
| (ii) Under ⅜ in. | 20.3 | 17.7 | 20.4 | 16.5 | 18.0 |
| Other heavy prod. | 53.0 | 41.8 | 57.4 | 33.4 | 35.1 |
| Ferro-concrete bars | 8.9 | 7.6 | 9.2 | 6.4 | 6.6 |
| Wire rods .. .. | 23.3 | 21.5 | 23.2 | 20.9 | 22.3 |
| Arches, etc. .. | 11.0 | 8.6 | 10.7 | 8.6 | 8.6 |
| Other light sections | 38.7 | 29.1 | 36.1 | 30.6 | 30.4 |
| Bright steel bars .. | 7.0 | 6.2 | 7.2 | 6.8 | 7.0 |
| Hot-rolled strip .. | 23.1 | 22.6 | 27.2 | 24.9 | 27.2 |
| Cold-rolled strip .. | 7.1 | 7.0 | 8.4 | 7.1 | 7.7 |
| Sheets, inc. coated: | | | | | |
| (i) Hot-rolled .. | 13.0 | 10.6 | 12.6 | 10.3 | 10.4 |
| (ii) Cold reduced | 29.1 | 31.1 | 31.2 | 33.5 | 34.2 |
| Tinplate: | 18.8 | 18.7 | 17.4 | 21.8 | 21.2 |
| Blackplate .. | 1.0 | 0.8 | 0.8 | 0.8 | 0.8 |
| Tubes up to ¼ in. | 22.1 | 19.0 | 21.6 | 19.4 | 18.7 |
| Tube, pipe fitting .. | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 |
| Tyres, wheels axles | 5.1 | 4.5 | 5.4 | 3.3 | 2.9 |
| Forgings (excl. drop forgings) .. | 3.1 | 2.6 | 3.1 | 2.5 | 2.2 |
| Steel castings .. | 4.6 | 4.2 | 4.8 | 3.6 | 3.7 |
| Tool and magnet .. | 0.3 | 0.2 | 0.3 | 0.2 | 0.2 |
| Total .. .. | 342.3 | 300.5 | 350.3 | 289.2 | 299.0 |
| *Alloy steel* .. .. | 17.8 | 16.1 | 20.1 | 16.2 | 17.3 |
| Total deliveries from UK production[6] .. | 360.1 | 316.6 | 370.4 | 305.4 | 316.3 |
| *Add:* Imported finished steel .. | 9.6 | 7.1 | 11.2 | 3.9 | 4.5 |
| | 369.7 | 323.7 | 381.6 | 309.3 | 320.8 |
| *Deduct:* Intra-industry conversion[7] .. | 48.2 | 41.2 | 51.2 | 44.2 | 45.9 |
| Total deliveries new material .. .. | 321.5 | 282.5 | 330.4 | 265.1 | 274.9 |

TABLE 4.—*Production of Pig-iron and Ferro-alloys*

| District. | Furnaces in blast. | Hematite. | Basic. | Foundry. | Forge. | Ferro-alloys. | Total. |
|---|---|---|---|---|---|---|---|
| Derbys, Leics, Notts, Northants, and Essex | 20 | 0.8 | 20.8 | 16.3 | 0.3 | — | 38.2 |
| Lancs (excl. N.W. Coast), Denbigh, Flints, and Cheshire .. | 7 | — | 17.4 | — | — | 1.3 | 18.7 |
| Yorks (excl. N.E. Coast and Sheffield) .. .. | | | | | | | |
| Lincs .. .. | 8 | — | 40.7 | — | — | — | 40.7 |
| North-East Coast | 17 | 3.0 | 38.4 | — | — | 0.8 | 42.2 |
| Scotland .. .. | 6 | 0.6 | 14.1 | 0.6 | — | — | 15.3 |
| Staffs, Shrops, Worcs, and Warwicks .. | 4 | — | 5.0 | 1.3 | — | — | 6.3 |
| S. Wales and Monmouthshire .. | 9 | 2.4 | 41.9 | — | — | — | 44.3 |
| Sheffield .. .. | 2 | — | 3.5 | — | — | — | 3.5 |
| North-West Coast | 7 | 10.8 | — | 0.3 | — | 0.9 | 12.0 |
| Total .. | 80 | 17.6 | 181.8 | 18.5 | 0.3 | 3.0 | *221.2 |
| February, 1959 .. | 81 | 20.4 | 179.0 | 19.0 | 0.3 | 3.1 | 221.8 |
| March, 1958 .. | 93 | 29.5 | 208.7 | 24.4 | 1.0 | 4.0 | 267.6 |

[1] Used in non-food manufacturing industries.

[2] Weekly average of calendar month.

[3] Stocks, mainly ingots and semi-finished, at the end of the year and months shown.

[4] Five weeks, all tables.

[5] Other than for conversion into any other form of finished steel listed.

[6] Includes finished steel produced in the UK from imported ingots and semi-finished steel.

[7] Material for conversion into other products also listed in this table.